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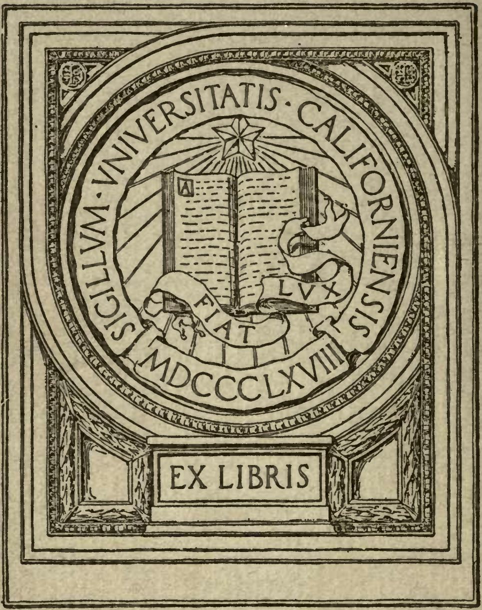
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MANUAL OF THE MOLLUSCA;

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OR,

RUDIMENTARY TREATISE

OF

RECENT AND FOSSIL SHELLS.

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BY

S. P. WOODWARD, F.G.S.

ASSOCIATE OF THE LINNÆAN SOCIETY;
ASSISTANT IN THE DEPARTMENT OF MINERALOGY AND GEOLOGY
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A. N. WATERHOUSE AND JOSEPH WILSON LOWRY.

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ERRATA AND ADDENDA.

Page 7 line 5 *for* " pterpoda" *read* " pteropoda."
— " 13 *for* " brachiapoda" *read* " brachiopoda."
11 " 16 *for* " pector" *read* " pecten."
15 " 30 *for* " Mr. Robert" *read* " Mr. George Roberts;" the statement is undoubtedly correct.
22 " 16 *for* " slerotic" *read* " sclerotic."
25 Note. Striped muscular fibre has been observed in *Salpa*. (Huxley.)
28 line 8 erase the words " when withdrawn."
28 Fig. 16 *a*, anterior; *p*, posterior; *l*, lateral; *r*, rachidian.
30 line 27 erase " and by four in the brachiopoda."
39 " 22 the " tubular structure" of *pinna* is probably occasioned by the growth of a confervoid sponge between the laminæ. (Quekett.)
46 " 13 erase the word " cylindrella."
50 " 7 *for* " brachiopoda" *read* " opistho-branches."
52 erase lines 20—23, and see p. 245.
54 line 12 *see* Supplement.
65 M. Verany and H. Müller have shown that the *Hectocotyle* is developed in place of the right arm of the third pair of the male cephalopod, and *spontaneously* detached. See SUPPLEMENT.
67 line 8 from bottom, *for* " dorsal" *read* " ventral."
68 *Tremoctopus* is a sub-genus of *Octopus*, not of *Philonexis*.
70 line 16 add " *Type*, Loligo Aalensis, Schubler."
71 " 14 *for* " Fidenas ? Gray" *read* " R. palpebrosa."
79 Note. *for* " the apocryphal genus *spongarium* was founded on" *read* " *most* of the so-called *spongaria* are."
89 Sub-genus 6, Diploceras (Salter). The shell is supposed to have resembled *Gonioceras*, and the external tube to be a simple cavity formed by the approximation of the lateral angles.
94 line 15 (and Pl. III. fig. 4) *for* " Rhothomagensis" *read* " Rothomagensis, from *Rothomagum*, Rouen."
100 " 6 *for* " riam" *read* " rima."
105 " 8 *for* " Strombidia, Sw." *read* " Rimella, Ag."
106 erase line 3.
108 *Admete* (viridula) is a boreal form of Cancellaria, without plaits.

252013

Page 108 Cuma (angulifera) and Rapana (p. 109) are Purpuræ.
115 Cithara, Schum. belongs to *Fam. Conidæ.*
127 line 15 *add Syn.* Polyphemopsis, Portlock.
128 " 2 *for* " Triphoris," *read* " Triforis."
— " 9 *for* " eidos, facies" *read* " ides, patronymic termination."
129 *Fastigiella; Fossil,* Eocene. Paris (*Cerithium rugosum,* Lam.)
131 *for* " Pachystoma, Gray" *read* " Chilostoma, Desh."
132 Remove *Aclis* to the Pyramidellidæ.
— line 3 from bottom, (and Pl. IX. fig. 4) *for* " A. perforata, Mont. MS." *read* " A. supranitida, Wood."
135 line 4 erase " Nina, Gray."
— " 6 *for* " many-whirled" *read* " few-whirled."
136 (and Pl. IX. fig. 24) *for* " Litiopa *bombix*" *read* " L. bombyx."
142 *Navicella* inhabits freshwaters, adhering to stones and plants.
145 line 30 *for* " Maclurea, Les." *read* " Straparollus, D'Orb."
154 line 6 from bottom, *for* " Pattison" *read* " R. Patterson."
155 *Metoptoma* is a sub-genus of *Pileopsis,* not Patella.
Exp. Plates. Pl. V. fig. 5, *for* " California" *read* " W. Indies."
" — fig. 7, *for* " China" *read* " W. Indies."
" VII. fig. 15, *for* " Philippines" *read* " Tahiti."
" XII. fig. 13, *for* " Australian Ids." *read* " Tahiti."
" — fig. 43, *for* " *Sby.* Philippines" *read* " Gray, ½ Jamaica.
Page 165 *Glandina;* the Lusitanian Bulimus Algirus belongs to this genus.
168 line 15 *insert* " devour" *before* " animal substances."
177 " 16 *for* " Megaloma" *read* " Lomastoma."
253 " 3 from bottom, erase " Ætheria has a large foot."
261 " 25 erase " *Aucella,* Keyserling;" it is a pearly shell, distinct from *Monotis* of Münster.

NOTICE.

In the long interval since the publication of the first part of this Manual, materials have so accumulated on the writer's hands, that it has been found impracticable to condense them within the space at first contemplated. The illustrations also have been more numerous than was originally expected, and occupy considerably more room. But although a Supplement has become inevitable, the publisher has allowed an extra number of pages, in order to render the present part complete in itself. The writer hopes to make the Appendix more valuable by figures and descriptions of the animals of many hitherto undescribed Bivalve genera, the materials for which have already been placed at his disposal by Dr. J. E. Gray. The present part owes much to the assistance of Mr. Albany Hancock, of Newcastle; Mr. Thos. Davidson, F.G.S., and Mr. T. H. Huxley, F.R.S.

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A

MANUAL OF THE MOLLUSCA.

PART II.

CLASS II. GASTEROPODA.—ORDER II. Pulmonifera.

This order embraces all the land-snails and other *mollusca* which breathe air. They are normal gasteropods, having a broad foot, and usually a large spiral shell; their breathing-organ is the simplest form of lung, and is like the branchial chamber of the sea-snails, but lined with a network of respiratory vessels. One large division of the land-snails is furnished with an operculated shell; the rest are in-operculate, and sometimes shell-less.

The *pulmonifera* are closely related to the plant-eating sea-snails (*holostomata*), through *Cyclostoma*, and to the *nudibranches* by *Oncidium*. As a group, they are generally inferior to the sea-snails, on account of the comparative imperfection of their senses, and the union of the functions of both sexes in each individual.

SECTION A. In-operculata.

The typical pulmonifera vary much in appearance and habits, but agree essentially in structure. Most of them have sufficiently large shells; in the slugs, however, the shell is small and concealed, or rarely quite wanting. Snail-shells contain a larger proportion of animal matter than sea-shells, and their structure is less distinctly stratified (p. 40). In form, these shells represent many marine genera. The greater part are terrestrial, only some of the smaller families inhabit fresh-waters, or damp places near the sea. The respiratory orifice is small and valve-like,* to prevent too rapid desiccation in the land-snails, and to guard against the entry of water in the aquatic tribes. Land-snails are universally distributed; but the necessity for moist air, and the vegetable nature of their food, favour their multiplication in warm and humid regions; they are especially abundant in islands, whilst in hot and desert countries they appear only in the season of rain or dews. Their geological history is less complete than that of the purely marine orders; but their antiquity might be inferred from the distribution of peculiar genera in remote islands, associated with the living representatives of the ancient fauna of Europe. Fresh-water snails (*Limnæidæ*) occur in the English Weald, but fossil land-snails have not been found in strata older than the Tertiary in Europe, and then under forms generically, and even in one instance specifically, identical with living types of the new world (*Megaspira, Proserpina, Glandina,* and *Helix labyrinthica*). In the coal-strata of Nova Scotia, Sir Chas. Lyell has discovered a single specimen of a reversed and striated shell, apparently a *Clausilia.*

---

* Hence they are called *Adelo-pneumona* (concealed-lunged) by Gray.

The *lingual dentition* of the pulmonifera confirms, in a remarkable manner, those views, respecting the affinities of the order, and its zoological value, which have been deduced from the more obvious characters afforded by the animal and shell. The operculated land-snails have seven-ranked teeth, like *Paludina* and *Litorina.* The in-operculated air-breathers have, without known exception, rows of very numerous, similar teeth, with broad bases, resembling tessellated pavement. Their crowns are recurved, and either aculeate or dentated. The lingual ribbon is very broad, often nearly as wide as it is long; and the number of teeth in a row (though usually a third less) is sometimes as great, or even greater, than the number of rows. The rows of teeth are straight or curved or angulated; when the rows are straight the teeth are similar in shape; curves indicate gradual changes, and angles accompany sudden alterations of form.

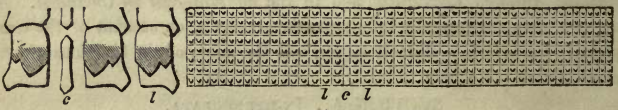
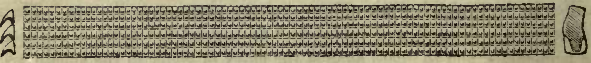


Fig. 90. *Lingual teeth of Achatina.**

The absolute number of teeth is only a specific character, and is usually greatest in the larger species; but the *Helicellæ* have fewer teeth in proportion than the *Helices*, and Velletia has fewer than *Ancylus.* The anomalous genus *Amphibola* (p. 139) has an unusually broad tongue, armed with teeth similar to those of the snail.



Fig, 91. *Lingual teeth of Amphibola.*†

About one-third the lingual membrane is spread over the tongue; the rest has its margins rolled together, and is lodged in a sac or dental canal, which diverges downwards from the posterior part of the mouth, and terminates outside the buccal mass of muscles.*

---

* Fragment of the lingual membrane of *Achatina fulica,* with central and lateral teeth more enlarged, from a specimen communicated by J. W. Laidlay, Esq.

† Part of the tongue of *Amphibola avellana,* from a preparation by J. W. Wilton, Esq., of Gloucester.

The mode in which the tongue is used, may be seen by placing a *Limnæa* or *Planorbis* in a glass of water, inside which the green *conferva* has begun to grow; they will be observed incessantly cleaning off this film. The upper lip with its mandible is raised, the lower lip—which is horse-shoe shaped—expands, the tongue is protruded and applied to the surface for an instant, and then withdrawn; its teeth glitter like glass-paper, and in *Limnæa* it is so flexible, that frequently it will catch against projecting points, and be drawn out of shape slightly as it vibrates over the surface.

"The development of the (in-operculate) Pulmonifera has been worked out by Van Beneden and Windischmann,† by Oscar Schmidt,‡ and by Gegenbaur;§ the memoir, by the last named author, contains full information respecting *Limax* and *Clausilia*, and some important notices with regard to *Helix*.

"The yelk undergoes complete division. The first stage of development consists in the separation of the embryo into mantle and foot. The anterior part of the body, in front of the mantle, dilates and forms a contractile sac—the homologue of the *velum* of marine gasteropods—which in *Doris*, *Polycera*, and *Æolis*, has been seen to exhibit similar contractions. (*Gegenbaur.*) To this contractile vesicle the name of *Yelk-sac* was given by Van Beneden and Windischmann, but it is a very different organ from the true Yelk-sac, which exists in the Cephalopoda alone among molluscs.

"A similar contractile dilatation exists at the end of the foot—and the contractions of this 'caudal' vesicle and of the 'vitellary' vesicle alternate, so as to produce a kind of circulation before the development of the heart.

"The oral tentacles and parts about the mouth are the last to be completed.

"A peculiar gland exists during the embryonic period, attached to the parietes of the 'vitellary' vesicle, which Gegenbaur and Schmidt compare to a Wolffian body.

"Gegenbaur draws attention to the fact, that the first rudiment of the shell in *Limax*, *Clausilia* and probably *Helix*, is not secreted on the exterior of the mantle, as in other *gasteropoda;* but is deposited, in the form o calcarious granules, within its substance.

"Besides, therefore, the possession of Wolffian bodies, and of especial contractile organs, which subserve respiration and circulation during embryonic life—the terrestrial *gasteropoda* are further distinguished by the peculiar mode of development of their shells—if the observations upon *Clausilia* and *Helix* may be extended to the rest. The first development of the shell within the substance of the mantle (a relation found hitherto only in the *Cephalopoda*) is up to the present time a solitary fact, without parallel among the other gasteropodous families." (*Huxley.*)

---

* Thomson, An. Nat. Hist. Feb. 1851.

† Recherches sur l'embryogenie des Limaces. Müller's Archiv. 1841.

‡ Ueber die Entwickelung von *Limax agrestis* Müller's Archiv, 1851.

§ Beiträge zur Entwickelungs geschichte der Land-gasteropoden. Siebold and Kölliker's Zeitschrift, 1852.

FAMILY I. HELICIDÆ.* Land-snails.

Shell external, usually well developed, and capable of containing the entire animal; aperture closed by an *epiphragm* during hybernation.†

Animal, with a short retractile head, with four cylindrical, retractile tentacles, the upper pair longest and bearing eye-specks at their summits. Body spiral, distinct from the foot; respiratory orifice on the right side, beneath the margin of the shell; reproductive orifice near the base of the right ocular tentacle; mouth armed with a horny, dentated, crescent-shaped upper mandible; lingual membrane oblong, central teeth in-conspicuous, laterals numerous, similar. (See Intr. p. 17.)

HELIX, L.‡

Type, H. pomatia, L. Roman snail. *Etym. Helix*, a coil.

Shell umbilicated, perforated or imperforate; discoidal, globosely-depressed or conoidal; aperture transverse, oblique, lunar or roundish; margins distinct, remote or united by callus.

Animal with a long foot, pointed behind; lingual teeth usually in straight rows, edge-teeth dentated.

Distr. including the sub-genera, above 1,200 sp. (several hundred sp. are undescribed). World-wide; ranging northward as far as the limit of trees, and southward to Tierra-del-fuego, but most abundant by far in warm and humid climates. M. D'Orbigny observed 6 sp. at elevations exceeding 11,000 feet, in S. America, and Layard found *H. gardeneri* at the height of 8,000 feet in Ceylon. The species of tropical and southern islands are mostly peculiar. Several of the smaller British species, and even the large garden-snail (*H. aspersa*), have been naturalised in the most remote colonies. The Neapolitans and Brazilians eat snails.

Fossil (extinct) sp. about 50. Eocene —. Europe.

Sections; Acavus, Montf. Shell imperforate. H. hæmastoma, Pl. XII. fig. 1.

Geotrochus (lonchostoma) Hasselt, Trochiform, flat beneath.

Polygyra, Say. Depressed, many-whirled. H. polygyrata, Pl. XII. fig. 2.

---

* The account of this family is chiefly taken from Dr. L. Pfeiffer's *Monographia Heliceorum.*

† The *epiphragm* is a layer of hardened mucus, sometimes strengthened with carbonate of lime; it is always minutely perforated opposite the respiratory orifice.

‡ The synonomy of the genus would fill several pages. See Intr. 1, p. 59.

Tridopsis, Raf. Aperture contracted by tooth-like projections. H. hirsuta, Pl. XII. fig. 5.

Carocolla, Lam. Peristome continuous. H. lapicida, Pl. XII. fig. 3.

Sub-genera. Anastoma, Fischer. (Tomigerus, Spix.) H. globulosa Pl. XII. fig. 4. Aperture of adult turned upwards, ringent; 4 sp. Brazil. *Hypostoma* (Boysii) Albers, is a minute Indian snail, in which the aperture is similarly distorted. *Lychnus* (Matheroni, Req.) has a similar shell, but no apertural teeth; 3 sp. occur in the Eocene Tertiary of the S. France.

Streptaxis, Gray. H. contusa, Pl. XII. fig. 6. Sub-globose, lower whirls receding from the axis of the upper; 24 sp. Brazil, W. Africa, Mascarene Ids. S. Asia.

Sagda, Beck. H. epistylium, Pl. XII. fig. 7. Imperforate, globosely conoid, close-whirled, aperture lamellate within, lip sharp; 3 sp. Jamaica.

Prosérpina (nitida) Guilding. Shell depressed, shining, callous beneath; aperture toothed inside; peristome sharp. *Distr.* 6 sp. Jamaica, Cuba, Mexico. *Fossil,* Eocene—. I. Wight (*F. Edwards*).

Helicella, Lam.* *Type,* H. cellaria, Pl. XII. fig. 8. Shell thin, depressed; peristome sharp, not reflected. Lingual edge-teeth aculeate. 90 sp.

Stenopus (cruentatus) Guild. *Syn.* Nanina (citrina) Gray; Ariophanta (lævipes, Pl. XII. fig. 9) Desm. Shell thin, polished; peristome thin, not reflected. Animal with the tail truncated and glandular, like *Arion;* mantle-margin produced, partly covering the shell. *Distr.* 70 sp. S. Asia and Ids. N. Zealand, Pacific Ids. W. Indies.

VITRINA, Draparnaud, Glass-snail.

Type, V. Draparnaldi, Pl. XII. fig. 28. *Syn.* Helicolimax, Fer.

Shell imperforate, very thin, depressed; spire short, last whirl large; aperture large, lunate or rounded, columellar margin slightly inflected, peristome often membranous.

Animal elongated, too large for complete retraction into the shell; tail very short; mantle reflected over the shell-margin, and furnished with a posterior lobe on the right side. Lingual teeth (of type) 100 rows of 75 each; marginal teeth with a single, long, recurved apex (*Thomson*). Occasionally animal-feeders, like the slugs.

V. Cuvieri and *Freycineti* (Helicarion Fer.) tail longer, more abruptly truncated, with a caudal gland like *arion,* mantle more developed.

Distr. 64 sp. Old World, 58; Greenland, 1; Brazil, 5.

Sub-genera. Daudebardia, Hartm. (Helicophanta, Fér.) V. brevipes, Pl. XII. fig. 29. Shell perforated, horizontally involute; aperture oblique, ample; 3 sp. Central Europe.

Simpulopsis (sulculosa) Beck; shell succinea-shaped. 5 sp. Brazil.

---

* For this group Mr. Gray formerly employed the name *Zonites,* given originally by Montfort to Helix Algira; in his later works be adopts *Helicella.*

SUCCINEA, Draparnaud. Amber-snail.

Type, S. putris, Pl. XII. fig. 23.

Syn. Cochlohydra, Fér. Helisiga (S. Helenæ) Less. Amphibulima (patula) Beck; Pelta (Cumingii) Beck.

Shell imperforate, thin, ovate or oblong; spire small; aperture large, obliquely oval; columella and peristome simple, acute.

Animal large, tentacles short and thick, foot broad; lingual teeth like *helix;* S. putris has 50 rows, of 65 teeth each (*Thomson*). Inhabits damp places, but rarely enters the water.

Distr. 68 sp. Europe 5, Africa 3, India 1, Australia 1; Pacific Ids. 17, N. America 14, S. America 11, W. Indies 11. *Fossil.* Eocene, Brit.

Sub-genus. Omalonyx, D'Orb. O. unguis. Pl. XII. fig. 24. Shell oval, convex, translucent, spire nearly obsolete, margins sharp. Animal large, slug-like; shell placed on the middle of the back, with the mantle slightly reflected upon it all round. *Dist.* 2 sp. Bolivia; Juan Fernandez.

BULIMUS, Scopoli.

Etym. ? *Boulimos,* extreme hunger (in allusion to its voracity!)

Syn. Bulinus, Brod. (not Adans). *Type.* B. oblongus. Pl. XII. fig. 10.

Shell oblong or turreted; aperture with the longitudinal margins unequal, toothless or dentate; columella entire, revolute externally or nearly simple; peristome simple or expanded.

Animal like Helix. *B. ovatus* attains a length of 6 inches, and is sold in the market of Rio; it oviposits amongst dead leaves, the eggs have a brittle shell, and the young when hatched are an inch long. (See p. 54, fig. 31.)

Sections. Odontostomus (gargantuus) Beck, aperture toothed, 13 sp. Brazil.

Pachyotis, Beck (Caprella, Guild.) fig. 91.*

Partula, Fér. P. faba. Pl. XII. fig. 13, *Tahiti.* 26 sp. Asiatic, Australian and Pacific Ids. 24; S. America 2. The animal is ovo-viviparous.

Gibbus (*Lyonnetianus*) Montf. Shell humpbacked; Mauritius, 2 sp.

Bulimulus, Leach. B. decollatus. Pl. XII. figs. 11, 12. Shell small, lip acute. Above 300 sp. England 3 sp.

Zua, Leach. Z. lubrica. Pl. XII. fig. 14. Shell polished, columella slightly truncated.

Azeca, Leach. A. tridens. Pl. XII. fig. 15. Shell polished, peristome thickened and toothed.

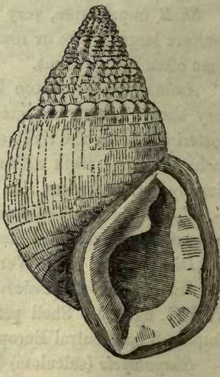


Fig. 91* *B. auris-vulpina.*

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[*] Fig. 91. *Bulimus auris-vulpina,* Chemn. The great extinct land-snail of St.

Distr. 650 sp. Europe 30, Asia 130, Australia and Pacific Ids. 46, Africa 50, S. States 3, Tropical and S. American 330.

Fossil. 30 sp. Eocene —. Europe, S. Helena, Australia, W. Indies. B. Guadalupensis occurs in modern limestone, with human remains.

ACHATINA, Lamarck. Agate-shell.

Type, A. variegata, Pl. XII. fig. 22.

Syn. Cochlitoma, Fér. Columna, Perry. Subulina (octona) Beck. Liguus (virgineus) Montf. Cionella (acicula) Jeffr.

Shell imperforate, bulimiform; columella twisted, and truncated in front; aperture oval, angular above; peristome simple, acute.

Animal snail-like. The great African Achatinæ are the largest of all land-snails, attaining a length of 8 inches; their eggs exceed an inch in length, and have a calcarious shell.

Distr. 120 sp. Europe 9, Africa 38, Asia 8, tropical America 29.

Fossil. 14 sp. Eocene —. Europe; St. Helena.

Sub-genera. Glandina (voluta) Schum. (Oleacina, Bolten; Polyphemus, Montf.) *Shell* oblong, fusiform; aperture narrow, elliptical. *Animal* twice as long as the shell; eye tentacles deflected at the tips, beyond the eyes; vibracula much shorter, also deflected; lips elongated, tentacular. Frequents low and moist situations; in confinement one refused vegetable food, but at another snail. (*Say.*) 40 sp. W. Indies, Central America, Mexico, Florida. *Fossil.* Eocene —. *Glandina costellata.* I. Wight. (*F. Edwards.*)

Achatinella (vulpina) Sw. (Helicteres, Fér.) Columella twisted into a strong, tooth-like fold. Sandwich Ids. 25, Mariannes 2, Ceylon 1.

PUPA, Lamarck. Chrysalis-shell.

Type, P. uva. Pl. XII. fig. 16. *Syn.* Torquilla (juniperi) Studer.

Shell rimate or perforate, cylindrical or oblong; aperture rounded, often toothed;* margins distant, mostly united by a callous lamina.

Animal with a short foot, pointed behind; lower tentacles short.

Distr. 160 sp. Greenland 1, Europe 76, Africa 23, India 12, Pacific Ids. 2, N. America 30, S. America 5. *Fossil.* 40 sp. Eocene —. Europe.

Sub-genus. Vertigo, Müll. V. Venetzii. Pl. XII. fig. 17. Shell minute, sometimes sinistral. Animal with the oral tentacles rudimentary or obsolete. 12 sp. Old World.

CYLINDRÉLLA, L. Pfeiffer. Cylinder-snail.

Type, C. cylindrus. Pl. XII. fig. 20.†

Helena; from a specimen presented by Chas. Darwin, Esq. See "Journal of a Voyage round the World."

* Dr. Pfeiffer terms those teeth *parietal* which are situated on the body-whirl those on the outer lip *palatal,* and on the inner lip *columellar.*

† The figure is taken from a sp. in Mr. Cuming's cabinet, in which the empty apex, usually decollated, remains attached to the adult shell.

Syn. Brachypus, Guild. Siphonostoma, Sw.

Shell cylindrical or pupiform, sometimes sinistral, many-whirled, apex of the adult truncated, aperture round, peristome continuous, expanded.

Animal similar to *clausilia;* foot short, oral tentacles minute.

Distr. 50 sp. W. Indies 35, Mexico 5, Texas 2, S. America 1.

BALÈA, Prideaux.

Type, B. perversa. Pl. XII. fig. 21. *Syn.* Fusulus, Fitz.

Shell slender, usually sinistral, fusiform, multispiral, aperture ovate; peristome acute, margins unequal, wall of the aperture with one slight plait; columella simple.

Animal snail-like; teeth 20.20; rows 130 (*Thomson*).

Distr. 8 sp. Norway, Hungary, New Granada, Tristan d'Acunha. The British sp. is found, very rarely, in Porto Santo, only on the highest peak, at an elevation of 1,665 feet. (*Wollaston.*)

Sub-genus. Megaspira (elatior) Lea. Pl. XII. fig. 18. Shell dextral, with the columella transversely plaited. *Distr.* 1 sp. Brazil. *Fossil,* 1 sp. Eocene —. Rheims.

TORNATELLINA, Beck.

Etym. Diminutive (or patronymic termination) of *tornatella.*

Type, T. bilamellata, Ant. *Syn.* Strobilus, Anton. Elasmatina, Petit.

Shell imperforate, ovate or elongated; aperture semi-lunar, margins unequal, disunited; columella twisted, truncated; inner lip 1-plaited.

Distr. 11 sp. Cuba 1, S. America 2, Juan Fernandez 2, Pacific Ids. 5, N. Zealand 1.

PAXILLUS, A. Adams.

Type, P. adversus, Ad. Borneo.

Shell small, pupiform, sinistral, rimate; spire pointed; aperture semi-ovate, ascending on the body-whirl; inner lip spreading, 1-plaited, outer lip expanded, notched in front.

CLAUSILIA, Draparnaud.

Etym. Dimin. of *clausum* a closed place. *Syn.* Cochlodina, Fér.

Ex. C. plicatula, Drap. (= C. Rolphii, Leach). Pl. XII. fig. 19.

Shell fusiform, sinistral; aperture elliptical or pyriform, contracted by lamellæ, and closed when adult by a moveable shelly plate (*clausium*) in the neck.

Animal with a short, obtuse foot; upper tentacles short, lower very small. *C. bidens* has 120 rows of 50 teeth; C. nigricans 90 rows of 40 teeth each.

Distr. Above 200 sp. Europe 146, Asia 48, Africa 4, S. America 3.

Fossil, 20 sp. Eocene —. Brit. France. Coal-strata, N. Scotia. (*Lyell.*) *C. maxima,* Grat. Miocene, Dax is two inches in length.

FAMILY II. LIMACIDÆ. Slugs.

Shell small or rudimentary, usually internal, or partly concealed by the mantle, and placed over the respiratory cavity.

Animal elongated; body not distinct from the foot; head and tentacles retractile; tentacles 4, cylindrical, the upper pair supporting eyes; mantle small, shieldshaped; respiratory and excretory orifices on the right side.

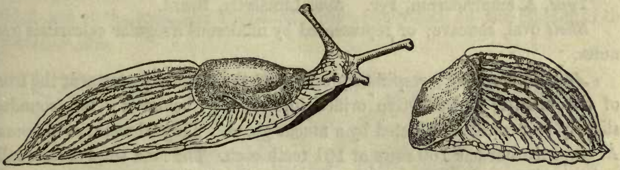

Fig. 92. *Limax Sowerbii Fér. Brit.*

LIMAX, L. Slug.

Type, L. maximus. Pl. XII. fig. 25. (L. cinereus, Müll.)

Shell internal, oblong, flat, or slightly concave beneath, nucleus posterior; margin membranous; epidermis distinct.

Animal, foot pointed and keeled behind; mantle shieldshaped, on the front of the back, granulated or marked with concentric striæ; respiratory orifice on the right side, near the posterior margin of the mantle; reproductive orifice near the base of the right ocular tentacle; lingual teeth tricuspid, those near the margin simple, aculeate.

The slugs are connected with the snails by *Vitrina;* their teeth are similar, but have more elongated cusps. The creeping-disk, or *sole* of the foot, extends the whole length of the animal; but they frequently lift up their heads, like the snails, and move their tentacles in search of objects above them. They often climb trees, and some can lower themselves to the ground by a mucous thread. When alarmed they withdraw their heads beneath the mantle, as in fig. 92. Slugs feed chiefly on decaying vegetable and animal substances; they oviposit at any time of the spring and summer when the weather is moist, and bury themselves in drought and frost. *Limax noctilucus,* Fér. (Phosphorax, Webb.) found in Teneriffe, has a luminous pore in the posterior border of the mantle.

Distr. 22 sp. Europe, Canaries, Sandwich Ids.

Fossil. Eocene —. Brit. The Ancylus ? latus, Edw. of the I. Wight appears to be a Limax.

Sub-genus. Geomalacus (*maculosus*) Allman. Ireland. *Shell* unguiform. *Animal* with a mucus gland at the extremity of the tail; respiratory orifice near the right anterior border of the mantle.

INCILARIA, Benson.

Type, I. bilineata, Cantor, Chusan. *Syn.* ? Meghimatium, Hasselt.

Animal elongated, tapering behind, entirely covered by a mantle; tentacles 4, the upper bearing eyes, the lower entire; respiratory orifice on the right side, near the front of the mantle. Lon. 1½ inches.

Philomycus (Raf.) Fér. = Tebennophorus, Binney, 1842, Bost. Soc. Journ. (Helix Carolinensis, Bosc) is also a slug with a long mantle.

ARION, Férussac. Land-sole.

Type, A. empiricorum, Fér. *Syn.* Limacella, Brard.

Shell oval, concave; or represented by numerous irregular calcarious granules.

Animal, slug-like; respiratory orifice on the right side, towards the front of the mantle; reproductive orifice immediately below it; tail rounded, slightly truncated, terminated by a mucus-gland. Lingual teeth, as in *limax;* A. empiricorum has 160 rows of 101 teeth each. The land-soles occasionally animal substances, such as dead worms, or injured individuals of their own species. They lay 70-100 eggs, between May and September, are 26-40 days hatching, and attain their full growth in a year; they begin to oviposit a month or two before that period. The eggs of *A. hortensis* are very phosphorescent for the first 15 days. (*Bouchard.*)

Distr. 6 sp. Europe. Norway, Brit. Spain, S. Africa.

Fossil. Newer Pliocene, Maidstone. (*Morris.*)

Plectrophorus (*corninus*, Bosc) Fér. 3 sp. Teneriffe; represented as having a small conical shell on the tail; probably an erroneous observation.

PARMACELLA, Cuvier.

Type, P. Olivieri, Cuv. *Etym. parma*, a small shield.

Syn. ? Peltella (Americana), Van Beneden.

Shell concealed, oblong, nearly flat, apex sub-spiral.

Animal vitrina-like, with an ample foot, pointed behind, and furnished with a mucus-pore; mantle small, shield-like, in the middle of the back, partly or entirely concealing the shell.

P. calyculata, Sby. (Cryptella, Webb,) Pl. 12, fig. 27, is patelliform, with an exposed papillary spire. *Distr.* 7 sp. S. Europe; Canary Ids. N. India.

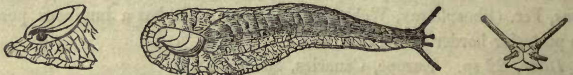

Fig. 93. *Testacella haliotoides, Fer.* *

TESTACELLA, Cuvier.

Shell small, ear-shaped, situated on the posterior extremity of the body.

Animal, slug-like, elongated and tapering towards the head; back with

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* Back view of a half-grown individual; side-view of shell on the tail, and front view of the head. From specimens communicated by Arthur Mackie, Esq., of Norwich.

2 principal lateral furrows, from which numerous vein-like grooves ramify; mantle not larger than the shell; respiratory orifice on the right side, beneath sub-spiral apex of the shell; reproductive orifice behind the right tentacle. The Testacella is subterranean in its habits, feeding on earth-worms, and visiting the surface only at night. Its lingual membrane is very large and wide, with about 50 rows of 20.20 teeth, which diminish rapidly in size towards the centre; each tooth is slender, barbed at the point, and slightly thickened at the base, and furnished with a projection on the middle of the posterior side.

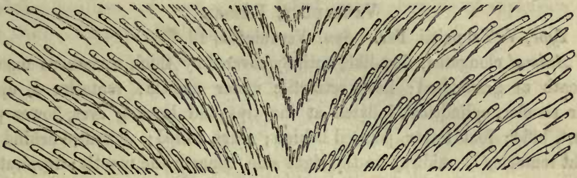

Fig. 94.*

Distr. 3 sp. S. Europe; Canary Ids. Brit. (introduced.)

FAMILY III. ONCIDIADÆ.

Animal, slug-like, destitute of any shell, completely covered by a coriaceous mantle; tentacles cylindrical, retractile, with eyes at their extremities; foot much narrower than the mantle.

ONCIDIUM, Buchanan.

Type, O. Typhæ, Buch. *Etym.* Diminutive of *Onkos*, a tubercle.

Animal oblong, convex, usually tuberculated; head with 2 retractile tentacles, bearing the eyes; mouth covered by a notched veil; no horny jaws; tongue broad, with above 70 rows of lingual teeth (in *O. celticum*), teeth 54.1.54;[†] the central teeth minute, triangular, with a single obtuse spine; laterals, slightly curved; heart opistho-branchiate; respiratory orifice posterior, distinct from the vent; sexes combined, ♂ organ under the right tentacle, ♀ at the posterior extremity of the body.

Distr. 16 sp. Brit. Medit. Red Sea, Mauritius, Australia, Pacific. The typical *Oncidia* live on aquatic plants, in the marshes of the warmer parts of the old world. Those which frequent sea-shores have been separated under the name *Peronia*, Bl. (Onchis, Fér). One species (*O. celticum*) is found

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[*] Part of the lingual membrane of *T. haliotides*, from a preparation by Fisher Cocken, Esq., of Botesdale. The dentition resembles that of *Ianthina*.

[†] This is a convenient mode of stating the number of lingual teeth in each row; it means that there is a single (symmetrical) tooth in the centre, and 54 lateral (unsymmetrical) teeth on each side. If the number of rows of teeth on the dental membrane is known, it may be added below, thus—*Peronia Mauritiana*, $\frac{80.1.80}{68}$.

on the coast of Cornwall, congregated in little groups, about a foot or two from the surface of the sea, where the waves break over them. They ascend and descend, so as to maintain their distance as the tides rise and fall; but will not bear long immersion in sea-water. (Couch.)

? *Buchanania* (*oncidioides*) Lesson. Named after Dr. F. Hamilton (Buchanan), the Zoologist of India. *Animal* oval, entirely covered by a simple mantle; respiratory orifice in the centre of the back; head with 4 tentacles, retractile beneath the mantle; foot oval, much smaller than the mantle; length 3½ inches. Coast of Chile. (Requires confirmation.)

VAGINULUS, Férussac.

Type, V. Taunaisii, Fér. *Syn.* Veronicella, Bl.

Animal elongated, slug-like, entirely covered by thick coriaceous mantle, smooth or granulated; head retractile under mantle; tentacles 4, upper pair slender, cylindrical, inflated at the tips and bearing eyes, lower pair short, bifid; foot linear, pointed behind; sexes united; ♂ orifice behind the right tentacle, ♀ midway on the right side, beneath the mantle: respiratory and excretory orifices at posterior extremity, between mantle and foot. Inhabits forests, in decayed wood and under leaves.

Distr. 6 sp. W. Indies, S. America, India, Philippines.

FAMILY IV. LIMNÆIDÆ.

Shell thin, horn-coloured; capable of containing the whole animal when retracted; aperture simple, lip sharp; apex sometimes eroded.

Animal with a short dilated muzzle; tentacles 2, eyes sessile at their inner bases; mouth armed with an upper mandible, tongue with teeth similar to *Helix*. The Limnæids inhabit fresh-waters, in all parts of the world; they feed chiefly on decaying leaves, and deposit their spawn in the form of oblong transparent masses, on aquatic plants and stones. They frequently glide beneath the surface of the water, shell downwards, and hybernate or restivate in the mud.

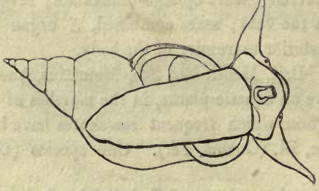

Fig. 95.

LIMNÆA,* Lamarck. Pond-snail.

Etym. Limnaios, marshy. *Type*, L. stagnalis, fig. 95. Pl. XII. fig. 30.

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* Adjectives employed as names for shells should have the feminine termination.

Shell spiral, more or less elongated, thin, translucent; body-whirl large, aperture rounded in front; columella obliquely twisted.

Animal with a short, broad head; tentacles triangular, compressed; lingual teeth (*L. stagnalis*) 55.1.55, about 110 rows, central teeth minute, laterals bicuspid, the inner cusp largest. *L. peregra* feeds on the green freshwater algae; *L. stagnalis* prefers animal substances.

Distr. 50 sp. Europe, Madeira, India, China, N. America.

Fossil, 70 sp. Wealden —. Brit. France.

Sub-genus, Amphipeplea, Nilsson. A. glutinosa, Pl XII. fig. 31. *Shell* globular, hyaline. *Animal* with a lobed mantle, capable of expansion over the shell. Europe; Philippines.

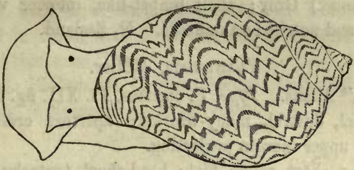

Fig. 96.

CHILINIA, Gray. Chilian-snail.

Ex. C. pulchra, D'Orb. fig. 96. *Syn.* Dombeya, D'Orb.

Shell oval, thin, ornamented with dark spots or wavy bands; columella thickened, with 1 or 2 strong prominent folds.

Distr. 14 sp. S. America; in clear running streams.

Fossil, 1 sp. Miocene, Rio Negro, Patagonia (D'Orb.)

PHYSA, Draparnaud.

Type, P. fontinalis, Pl. XII. fig. 32. *Etym. Physa*, a pouch.

Syn. Bulin, Adans. Rivicola, Fitz. Isidora, Ehr.

Shell ovate, sinistrally spiral, thin, polished; aperture rounded in front.

Animal with long slender tentacles; the eyes at their bases; mantle margin expanded and fringed with long filaments.

P. hypnorum (Aplexa, Fleming) has an elongated spire, and the mantle margin is plain. *Physopsis*, Krauss, S. Africa, has the base of the columella truncated. *Camptoceras* (terebra), Benson, India, has the whirls disunited, and the peristome continuous.

Distr. 20 sp. N. America, Europe, S. Africa, India, Philippines.

Fossil, 14 sp. Wealden —. Brit. France. The largest living sp. (P. Maugeræ, California) is 15 lines in length. A fossil sp. found at Grignon measures 26 lines, and another equally large occurs in India.

ANCYLUS, Geoffroy. River-limpet.

Etym. Ancylus (agkulos) a small round shield.

Type, A. fluviatilis, Müll. Pl. XII. fig. 33 (Patella lacustris, L.)

Shell conical, limpet-shaped, thin; apex posterior, sinistral; interior with a sub-spiral muscular scar.

Animal like Limnæa; tentacles triangular, with eyes at their bases; lingual teeth 37.1.37, in 120 rows, centrals small, laterals with long recurved hooks.

Distr. 14 sp. N. and S. America, Europe, Madeira. On stones and aquatic plants in running streams. *Fossil,* 8 sp. Eocene, Belgium.

Sub-genera, Velletia (oblonga, Lightf.) Gray. (Acroloxus, Beck) Shell and animal dextral; lingual teeth 40, in 75 rows. 3 sp. West Indies, Europe. *Fossil,* 2 sp. Eocene. Brit. France.

Latia (neritoides) Gray; shell limpet-like, interior with a transverse plate, turned up and notched on one side. N. Zealand.

PLANORBIS, Müller.

Syn. "Coret," Adans. *Type,* P. corneus, Pl. XII. fig. 34.

Shell discoidal, dextral, many-whirled; aperture crescentic, peristome thin, incomplete, upper margin projecting.

Animal with a short, round foot; head short, tentacles slender, the eyes at their inner bases; lingual teeth sub-quadrate, central and marginal bicuspid, laterals tricuspid; excretory orifices on left side of the neck.

Some species of *Planorbis* have the sutures and spire deeply sunk, and the umbilicus flattened; specimens occur with the spire elevated (fig. 97*). *P. contortus,* a minute species, has above 6,000 teeth, (*Cocken*). P. corneus secretes a purple fluid (Lister). *P. lacustris* (Segmentina, Fleming) has the whirls contracted, internally, by periodic septa, 3 in a whirl, with triradiate openings.

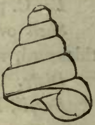
Fig. 97.

Distr. 60 sp. N. America, Europe, India, China.

Fossil, 60 sp. Wealder —. Brit. France.

FAMILY V. AURICULIDÆ.

Shell spiral, covered with horny epidermis, spire short, body-whirl large; aperture elongated, denticulated; internal septum progressively absorbed.

Animal with a broad and short muzzle, tentacles 2, cylindrical, the eyes sessile behind them; mantle-margin thickened; orifices as in the snails; foot oblong; sexes united; mouth with a horny upper jaw; lingual teeth numerous, central series distinct, hooked, tricuspid. *A. livida* has about 31 laterals (Loven); another species examined by Mr. Wilton has 11 large laterals and about 100 smaller (*uncini*) on each side, gradually diminishing towards the edge, fig. 98, *c.* central teeth, *l.* laterals.

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* *P. marginatus,* var. Rochdale, communicated by J. S. Gaskoin, Esq.

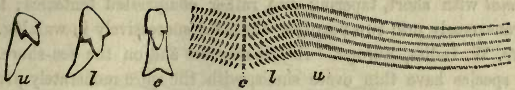

Fig. 98

The *Auriculæ* frequent salt-marshes, damp hollows, and places overflowed by the sea; they were long regarded as marine animals, and their shells confused with those of *Tornatella* and *Ringicula.*

AURICULA, Lamarck.

Type. A. Judæ. Pl. XII. fig. 35. *Etym. Auricula,* a little ear.

Syn. Cassidula, Fér (not Lam.) Marinula (pepita) King. Geovula, Sw.

Shell oblong, with thick, dark epidermis; spire obtuse; aperture long, narrow, rounded in front, with 2 or 3 strong folds on the inner lip; outer lip expanded and thickened.

Distr. 50 sp. Philippines, Celebes, Feejees, Australia, Peru.

Fossil, 20 sp. ? Neocomian —. France.

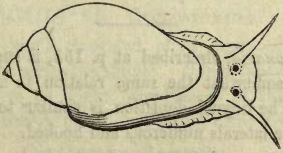

Fig. 99. *A. auris-felis.* (From Eyd. and Soul).

A. Judæ has truncated tentacles; the typical species are met with in the brackish-water swamps of tropical islands, on the roots of mangroves, and by small streams within the influence of the tide. One species has been observed by Mr. Adams in nearly 2 fathoms water.

Sub-genera, Polydonta, Fischer, *P. scarabæus,* Pl. XII. fig. 36. (Scarabus imbrium, Montf.) Shell oval, compressed; spire pointed many-whirled, with lateral varices; aperture toothed on both sides. *Distr.* 20 sp. India, Borneo, Celebes, Pacific Ids. Inhabits moist spots in woods near the sea, and is wholly terrestrial, feeding on decayed vegetables. (*Adams.*)

Pedipes (afra) Adans. *Shell* ovate, spirally striated, aperture denticulated on both sides; the animal loops in walking, like *truncatella. Distr.* W. Indies, Africa, Philippines, Pacific Ids. Under stones on the sea-shore.

Fossil, 5 sp. Eocene —. Brit. France.

CONOVULUS, Lamarck.

Type, C. coniformis, Brug. Pl. XII. fig. 37. (= Voluta coffea, L.?)

Syn. Melampus, Montf. Rhodostoma, Sw.

Shell obtusely cone-shaped, smooth; spire short, flat-whirled: aperture long, narrow; lip sharp, denticulated within; columella twisted in front; wall of the aperture with 1 or 2 spiral plaits.

Animal with short, tapering and rather compressed tentacles; foot divided transversely into two portions, advanced successively in walking.

Distr. W. Indies, Europe. In salt-marshes and on the sea-shore. The British species have thin ovate shells, with the spire moderately produced, and the aperture oval. They form the sub-genus *Alexia.* (denticulata) Leach. *Fossil.* Eocene. Brit. France.

CARYCHIUM, Müller.

Type, C. minimum, Pl. XII. fig. 39.

Syn. Auricella, Hartm.

Shell minute, oblong, finely striated transversely; aperture oval, toothed, margins thickened, united by callus.

Animal with 2 blunt, cylindrical tentacles; eyes black, sessile, near together, behind the tentacles.

Distr. 3 sp. Europe; N. America. At the roots of grass in damp places, especially near the sea.

Fossil. Miocene —. Europe.

The genus *Siphonaria,* described at p. 155, is supposed to be pulmoniferous, and to bear somewhat the same relation to *Auricula* that Ancylus does to *Limnaea.* The lingual dentition is similar to Auricula; the centre teeth are distinct, the laterals numerous and hooked.

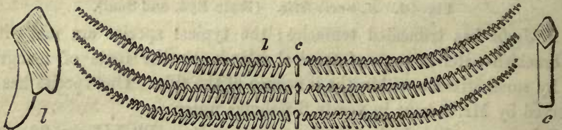

Fig. 100.*

SECTION B. OPERCULATA.†

The Operculated land-snails are exceedingly like periwinkles (*litorinæ*), and chiefly differ from them in the situations they inhabit, and the medium respired. They have a long truncated muzzle, 2 slender contractile tentacles, and the eyes are sessile on the sides of the head.‡ The mantle-margin is simple, and the pulmonary cavity is situated on the back of the neck, and quite open in front. Lingual ribbon narrow; teeth 7-ranked.

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* *Siphonaria* sp. from the Cape; three rows of teeth, *c* central, *l* laterals, from a preparation by J. W. Wilton, Esq, of Gloucester.

† *Phanero-pneumona* (open-lunged), Gray. The account of this group is chiefly taken from the Catalogue prepared by my friend Dr. Baird.

‡ The tentacles of the *helicidæ* are retractile, by inversion (p. 25) those of the *cyclostomidæ* are contractile only.

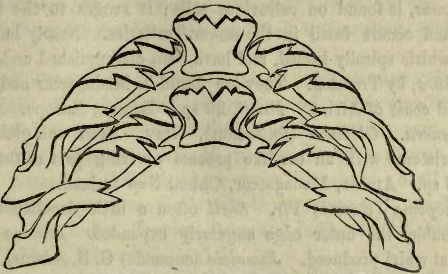

Fig. 101. *Lingual teeth of Cyclophorus.**

The sexes are distinct; the shell is spiral, and closed by an operculum, presenting many beautiful modifications of structure, characteristic of the smaller groups, which are often peculiar to limited regions, as in the *Helicidæ*. The oldest fossil species are found in the Eocene Tertiary.

FAMILY VI. CYCLOSTOMIDÆ.

Shell spiral, rarely much elongated, often depressed, spirally striated; aperture nearly circular; peristome simple. *Operculum* distinctly spiral.

Animal with the eyes on slight prominences at the outer bases of the tentacles; tentacles contractile only; foot rather elongated.

CYCLOSTOMA, Lamarck.

Etym. Cyclos circle, *stoma* mouth. *Type,* C. elegans, Pl. XII. fig. 40.

Syn. Leonia (mammillaris) and Lithidion, Gray.

Shell turbinated, thin, axis perforated; aperture oval; peristome continuous, simple, straight or expanded; epidermis very thin. Operculum shelly, pauci-spiral.

Animal with clavate tentacles; sole of the foot divided by a longitudinal groove, the sides moved alternately in walking; the end of the long muzzle is also frequently applied, as by the looping-snails (Truncatellæ), and used to assist in climbing.

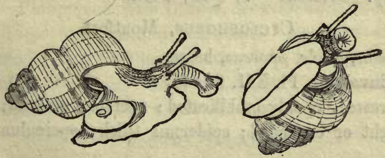

Fig. 102. *Cyclostoma elegans, from Charlton, Kent.*

Distr. Above 80 sp. S. Europe; Africa, Madagascar. The only British sp. *C. elegans*, is found on calcarious soils; it ranges to the Canaries and Algeria, and occurs fossil in the newer Tertiaries. Nearly half the species have the whirls spirally keeled, and have been distinguished under the name *Tropidophora*, by Troschel. They are found in Madagascar and the adjacent islands and coast of Africa. *Fossil*, 20 sp. Eocene, Europe.

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* *C. aquilum, Sby.* (original). From a specimen gathered by J. W. Laidlay, Esq. on the steps of the great idol-temple of Maulmein, Birmah.

Sub-genera. Otopoma (foliaceum), Gray. *Shell* sub-globose, umbilicated; peristome with an ear-like process covering part of the perforation. *Distr.* 15 sp. Arabia, Madagascar, China, New Ireland.

Choanopoma (lincina) Pfr. *Shell* often a little decollated; peristome usually double, the outer edge angularly expanded. *Lincina* (labeo) Br. has the last whirl produced. *Jamaicia* (anomala) C. B. Adams, has the operculum convex. *Distr.* 70 sp. W. Indies, and a few in Tropical America.

Cistula (fascia), Gray. = *Tudora* (megacheila), Gray. *Shell* ovate or elongated, apex usually decollated, peristome free; operculum with a thin shelly outer coat. *Chondropoma* (semilabre) Pfr. differs in the operculum being "sub-cartilaginous." *Distr.* About 70 sp. W. Indies; Tropical America, 8 sp.

Realia (hieroglyphica), Gray. = Hydrocæna (part) Parreyss, Omphalotropis, Pfr. Liarea (Egea), Gray. Bourciera (helicinæformis) Pfr. *Shell* turrited or turbinate, perforated; peristome simple, straight or expanded; operculum pauci-spiral, horny. *Distr.* 17 sp. Canaries, ? Mauritius, Pacific Ids. (Ecuador, *Bourciera.*)

Pomatias (maculatum), Studer. *Shell* slender, transversely striated; peristome reflected; operculum cartilaginous, concamerated within. *Distr.* 10 sp. S. Europe; Corfu.

? FERUSSINA, Grateloup.

Etym. named in honour of Baron Ferussac.

Type, F. anastomæformis, Gr. *Syn.* Strophostoma, Desh.

Shell rounded, depressed, umbilicated; whirls transversely striated above, spirally keeled below; aperture turned obliquely upwards, peristome simple, Operculum. ?

Fossil, 1 sp. Miocene —. Dax; Turin.

CYCLOPHORUS, Montfort.

Etym. Cyclos, circle, *phoreus*, bearer.

Type, C. involutus, Pl. XII. fig. 41.

Shell depressed, openly umbilicated; aperture circular; peristome continuous, straight or expanded; epidermis thick; operculum horny, many-whirled.

Animal with long, slender pointed tentacles; foot broadly expanded, not grooved.

Distr. About 90 sp. India, Philippines, New Zealand, Pacific Ids. Tropical America. *C. gibbus*, Fér. (Alycaeus, Gray) has the last whirl distorted.

C. cornu-venatorium, Sby. (Aulopoma, Troschel) Ceylon, has the peristome free when adult; the operculum is larger than the aperture, and reflected over it.

Sub-genera. Pterocyclos (rupestris), Benson. Myxostoma and Steganostoma, Troschel. *Shell* depressed, nearly discoidal, widely umbilicated; peristome expanded, produced into a little wing at the suture; operc. sub-cartilaginous, spirally lamellated. *Distr.* 16 sp. India, Ceylon, Birmah, Borneo?

Cyclotus (fuscescens) Guilding (Aperostoma, Troschel). *Shell* depressed, widely umbilicated; operculum shelly, whirls numerous, with raised margins. *Distr.* 44 sp. W. Indies, Tropical America, India, Asiatic Ids. *Fossil.* Eocene, I. Wight (F. Edwards).

Leptopoma (perlucidum) Pfr. *Shell* turbinated, peristome simple, reflected; operc. membranous. *Distr.* 29 sp. Philippines, India, New Guinea, N. Zealand, Pacific Ids.

*Megaloma** (cylindraceum) Guild. (Farcimen, Troschel.) *Shell* oblong or pupa-shaped, scarcely perforated, aperture circular; operc. thin, horny, many-whirled, flat. *Distr.* 19 sp. West Indies, Tropical America, Canaries, India, Mauritius. *Fossil.* Eocene —. Paris and I. of Wight (*E. Forbes.*)

Craspedopoma (lucidum) Pfr. *Shell* turbinate, rimate, a little contracted near the aperture; operc. round, horny, many-whirled. *Distr.* 3 sp. Madeira, Palma. *Fossil.* Eocene —. I. Wight, Madeira.

Cataulus (tortuosus) Pfr. *Shell* pupa-shaped, with the base keeled, producing a channel in the front of the aperture; operc. circular, horny, the whirls easily separable. *Distr.* 6 sp. Ceylon.

Diplommatina (folliculus) Benson. *Shell* minute, (1 sp. sinistral) conical, with costulated whirls; peristome double; operc. horny, multispiral. *Distr.* 3 sp. India.

PUPINA, Vignard.

Type, P. bicanaliculata, Sby. Pl. XII. fig. 42. Australian Ids.

Shell sub-cylindrical, usually polished; aperture circular, peristome thickened, notched in front and at the suture; operc. membranous, narrow-whirled. P. *grandis*, Forbes, has a dull epidermis.

Distr. 8 sp. Philippines, New Guinea, New Ireland, Louisiades.

Sub-genus, Rhegostoma (nunezii) Hasselt. Aperture with a narrow channel in the middle of the columellar side. 6 sp. Philippines. Nicobar. In *R. lubricum* (Callia, Gray) the sinus is obsolete. *R. pupiniforme* (Pupinella, Gray) is perforated, and has a dull epidermis.

HELICINA, Lamarck.

Type, H. Neritella, Lam.

Syn. Oligyra, Say. Pachytoma, Sw. Ampullina, Bl. Pitonillus, Montf.

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* Abridged from *Megaloma-stoma;* Swainson, who judiciously curtailed several preposterously long names, allowed this to remain.

Lomastoma. Sw. Err.

Shell globose, depressed or keeled, callous beneath; aperture squarish or semi-lunar; columella flattened; peristome simple, expanded; operc. shelly or membraneous, squarish or semi-ovate, lamellar.

Animal like *Cyclophorus;* lingual teeth 3.1.3. (Gray.)

Distr. 150 sp. W. Indies, 50; Tropical America, 44; Pacific Ids., 26; Australian Ids. 3; Philippines, 7.

Sub-genera. Lucidella, (aureola) Gray. Peristome more or less toothed internally; 8 sp. W. Indies, Tropical America.

Trochatella (pulchella), Sw. *Shell* not callous beneath; peristome simple, expanded. W. Indies 16 sp. Venezuela 1.

Alcadia, Gray. A. Brownei, Pl. XII. fig. 43. *Jamaica. Shell* helix-shaped, often velvety, callous beneath; columella flattened, straight; peristome slit in front; operc. shelly, semi-ovate, with a tooth-like process adapted to the slit in the peristome. *Distr.* 17 sp. Cuba, Jamaica and Haiti.

STOASTOMA, C. B. Adams.

Etym. Stoa pillared, *stoma,* month. *Type,* S. pisum, Ad.

Shell minute, globose-conic or depressed, spirally striated; aperture semi-oval; peristome continuous; inner margin straight, forming a small spiral keel round the umbilicus*;* operc. shelly, lamellar.

Distr. 19 sp. Jamaica. *S. succineum* (Electrina, Gray) has smooth whirls. I. Opara, Polynesia.

FAMILY VII. ACICULIDÆ.

Shell elongated, cylindrical; operculum thin, sub-spiral.

Animal with the muzzle rather produced, slender and truncated; eyes sessile on the upper part of the head, behind the base of the slender tentacles; foot oblong, short, pointed behind.

ACICULA, Hartmann.

Type, A. fusca, Pl. XII. fig. 44. *Syn.* Acme and Acmaea, Hartm.*

Shell minute. slender, nearly imperforate; peristome slightly thickened, margins sub-parallel, joined by a thin callus; operc. hyaline.

Distr. 5 sp. Brit. Germany, France; Vanicoro (on leaves). *A. fusca* is found in low, marshy situations, at the roots of grass; it occurs fossil in the Newer Pleiocene of Essex (J. Brown).

GEOMELANIA. Pfeiffer.

Type. G. Jamaicensis. Pfr. *Etym. Ge,* the ground (i.e. terrestrial).

Shell imperforate, turreted; aperture entire, effused; peristome simple, expanded; margins joined, basal produced into a tongue-shaped process; operc. oval, pellucid, whirls few, rapidly enlarging.

Distr. 21 sp. Jamaica.

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* All given in the same year, 1821; the name *Acmaea* having been employed by Eschscholtz for a genus of limpets, *Acicula* has been retained by Pfeiffer and Gray for this land-shell.

ORDER III. OPISTHO-BRANCHIATA.

Shell rudimentary or wanting. *Branchiæ* arborescent or fasciculated, not contained in a special cavity, but more or less completely exposed on the back and sides, towards the rear (*opisthen*) of the body. Sexes united. (*M. Edwards*).

The molluscs of this order may be termed sea-slugs, since the shell, when it exists, is usually small and thin, and wholly or partially concealed by the animal. When alarmed or removed from their native element, they retract their gills and tentacles, and present such a questionable shape that the inexperienced naturalist will be likely enough to return them, with the refuse of the dredge, into the sea. Their internal structure presents many points of interest; in some the gizzard is armed with horny spines, or large shelly plates; in others the stomach is extremely complicated, its ramifications and those of the liver being prolonged into the branches of the respiratory organ. The tongue is always armed, but the number and arrangement of the lingual teeth is exceedingly variable, even in the same family; usually the dental membrane is broad and short, with many similar teeth in each row. The alimentary canal terminates more in the rear of the body than in the other univalve shell-fish.* The gills are behind the heart, and the auricle behind the ventricle; conditions which characterize the embryonic state of the mollusca generally.

Comparatively little is known of the geographical distribution of these animals; they have been found wherever the requisite search has been made, and are probably much more numerous than at present estimated. The shell-bearing genera flourished in the period when the secondary strata were deposited. The living species are chiefly animal-feeders, preying on other shell-fish and on zoophytes.

SECTION A. TECTI-BRANCHIATA.†

Animal usually provided with a shell, both in the larval and adult state; branchiæ covered by the shell or mantle; sexes united.

FAMILY I. TORNATELLIDÆ.

Shell external, solid, spiral or convoluted, sub-cylindrical; aperture long and narrow; columella plaited; sometimes operculated.

Animal with a flattened, disk-like head, and broad obtuse tentacles; foot ample, furnished with lateral and operculigerous lobes.

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* In the cuttle-fishes and pteropods it is bent upon itself *ventrally*, in the sea-snails *dorsally*, terminating in front, near its origin; the vascular system partakes of this flexure, and the gills are in advance of the heart. (*Huxley*.)

† *Mono-pleuro-branchiata. Bl. Pomato-branchia*, (from *poma*, a lid). Wiegm. The order *Tecti-branchiata* of Cuvier included only the family *Bullidæ;* it is here made to comprise the *Infero-branches* also; no object being gained by the multiplication of descriptive epithets.

The shells of this family are chiefly extinct, ranging from the period of the coal strata, and attaining their greatest development in the cretaceous age. *Tornatella* is essentially related to *Bulla*, but presents some resemblance to the *Pyramidellidæ* in its plaited and operculated aperture; in *Tornatina* the nucleus, or apex, is sinistral. The spiral striae which ornament many of the species, are punctate, as in the Bullidæ; and the outer lip often remarkably thickened, as in Auricula.

TORNATELLA, Lamarck.

Type. T. tornatilis, Pl. XIV. fig. 1. *Syn*. Actæon, Montf. (not Oken), Dactylus (solidulus) Schum. ? Monoptygma (elegans) Lea.

Shell solid, ovate, with a conical, many-whirled spire; spirally grooved or punctate-striate; aperture long, narrow, rounded in front; outer lip sharp; columella with a strong, tortuous fold; operculum horny, elliptical, lamellar.

Animal white; head truncated and slightly notched in front, furnished posteriorly with recumbent tentacular lobes, and small eyes behind them, near their inner bases; foot oblong, lateral lobes slightly reflected on the shell. Lingual teeth 12.12, similar, with long simple hooks.

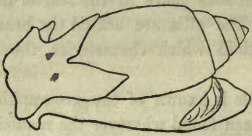

Fig. 103.

Distr. 16 sp. U. States, Brit. Senegal, Red Sea, Philippines, Japan, Peru. T. tornatilis inhabits deep water, (—60 fms. *Forbes*).

Fossil, 70 sp. Trias — Lias —. N. America, Europe, S. India.

Sub-genera, *Cylindrites* (Llhwyd) Lycett. C. acutus, Sby. Pl. XIV. fig. 2. (A.) Shell smooth, slender, sub-cylindrical, spire small, aperture long and narrow, columella rounded, twisted, and directed slightly outwards. (B.) Shell oval, spire sunk, whirls with acute margins. Bath Oolite, Brit.

Acteonina, D'Orb. Tornatellæ "without columella plaits," 30 sp. Carb.—Portlandian, (including *Cylindrites*).

Acteonella, D'Orb. A. Renauxiana, Pl. XIV. fig. 3. Shell thick, cone-like or convoluted, spire short or concealed, aperture long and narrow, columella with 3 strong and regular spiral plaits in front. *Distr*. 11 sp. Chalk; Brit. France.

Acteon Cabanetiana, D'Orb. (*Itieria*, Matheron, 1842) Coral-rag, France, belongs to the genus *Nerinea* (D'Orb.) p. 129.

CINULIA. Gray.

Type, C. avellana, Pl. XIV. fig. 4. *Syn*. Avellana and Ringinella, D'Orb.

Shell globular, thick, spirally groved and punctate, spire small; aperture narrow, rounded and sinuated in front; outer lip thickened and reflected; crenulated inside, columella with several tooth-like folds.

Fossil, 20 sp. Neocomian —Chalk. Brit. France.

RINGICULA, v. p. 112, Pl. V. fig. 21.

GLOBICONCHA, D'Orbigny.

Type, G. rotundata, D'Orb. *Fossil,* 6 sp. Chalk. France.

Shell ventricose, smooth, aperture crescent-shaped, simple, not toothed or thickened on the columellar side.

VARIGERA, D'Orbigny. 1850.*

Type, V. Guerangeri, D'Orb. *Fossil,* 8 sp. Neoc:—. Chalk. France.
Shell like *Globiconcha,* but with lateral varices.

TYLOSTOMA, Sharp. 1849.

Type, T. Torrubiæ, Sh. *Etym. Tulos,* a callosity, *stoma,* mouth.

Shell ventricose, smooth or punctate-striate, spire moderate, aperture ovate-lunate, pointed above, rounded in front; outer lip periodically (once or twice in a whirl) thickened inside and expanded, rising slightly; inner lip callous, spread over body-whirl.

Distr. 4 sp. L. Cretaceous rocks, Portugal.

? PTERODONTA, D'Orbigny.

Type, P. inflata, D'Orb. *Fossil,* 8 sp. Chalk. France.

Shell oblong, ventricose, spire elongated; aperture oval, lip slightly expanded, notched in front, and with a tooth-like ridge internally, remote from the margin.

? TORNATINA, A. Adams.

Type, T. voluta. Pl. XIV. fig. 5.

Shell cylindrical or fusiform, spire conspicuous, apex sinistral, suture channelled, columella callous, 1-plaited.

Animal with a broad, trigonal head, rounded in front; tentacular lobes triangular, with eyes at their outer bases; foot short, truncated in front.

Distr. 15 sp. W. Indies, U. States, Medit. Philippines, China, Australia. On sandy bottoms, ranging to 35 fms. (*Adams*).

Volvula, Adams (Bulla acuminata, Brug.) is a small convoluted shell, with the spire concealed, and the columella obsoletely folded; it is referred to *Cylichna* by Lovén, to *Ovulum* by Forbes. *Distr.* Brit. Medit. *Fossil.* Miocene —. Suffolk.

FAMILY II. BULLIDÆ.

Shell globular or cylindrical, convoluted, thin, often punctate-striated;

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* The dates of M. D'Orbigny's genera, given in the *Prodrome de Paleontologie,* are dates of *invention;* the names were not published, in many instances, until years afterwards.

spire small or concealed; aperture long, rounded and sinuated in front; lip sharp. No operculum.

Animal more or less investing the shell; head a flattened disk,* with tentacular lobes, often united; eyes immersed in the centre of the disk, or wanting; foot oblong, furnished with a posterior lobe (*meta-podium*), and side-lobes (*epipodia*); gill single on the right side of the back, covered by the shell; mantle-margin simple or expanded, and enveloping the shell. Lingual dentition very various; central teeth often wanting, laterals single or numerous. Gizzard armed with calcarious plates. Sexes united.

The *Bullidæ* are animal-feeders; they are said to use their lateral lobes for swimming. About 150 recent species have been described by Mr. A. Adams in Sowerby's *Thesaurus Conchyliorum*. *Fossil* species date from the lower Oolites; one is found in the Aralo-Caspian formation.

Bulla, Lamarck. Bubble-shell.

Type, B. ampulla, Pl. XIV. fig. 6. *Syn.* Haminea (hydatis) Leach.

Shell oval, ventricose, convoluted, external or only partially invested by the animal; apex perforated; aperture longer than the shell, rounded at each end; lip sharp.

Animal with a large cephalic disk, truncated in front, bilobed behind, the lobes laminated beneath; eyes sub-central, immersed or wanting; lateral lobes very large, reflected on the sides of the shell, posterior lobe covering the spire; foot quadrate; gizzard furnished with 3 chiton-like plates; teeth. ?

Bulla naucum (*Atys*, Montf. *Alicula*, Ehr. *Roxania*, Leach). Pl. XIV. fig. 7; has the columella twisted, and the spire entirely concealed.

Distr. 50 sp. In all temperate and tropical seas, especially on sandy bottoms, ranging from low water to 25 or 30 fms.

Fossil, 70 sp. Ool. —. S. America, U.S. Europe.

Sub-genera ? *Crypt-opthalmus* (smaragdinus) Ehr. Red sea. *Shell* scarcely convolute, fragile, oval, convex, without spire or columella. *Animal* semi-cylindrical, head with short tentacular lobes, eyes small, concealed under the lateral margins of the head, mantle and lateral lobes enveloping the shell.

Phaneropthalmus, A. Adams. (Xanthonella, Gray) B. lutea, Quoy, New Guinea. *Shell* oval, convex, pointed behind, columella margin with a curved process. *Animal* long, cylindrical, head with short tentacular lobes, eyes in middle of disk, lateral lobes enveloping.

Linteria, A. Adams (Glauconella, Gray), Bulla viridis, Rang. Pl. XIV. fig. 7. *Shell* oval, widely open, showing the rudimentary internal spire.

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* The cephalic expansion of the Bullidæ is formed by the fusion of the dorsal and oral tentacles. (*Cuvier.*) The tentacular lobes, or posterior part of the disk is supplied with nerves from the olfactory ganglia; the anterior portion of the disk receives branches from the labial nerve, which comes from the front margin of the cerebroid. (*Hancock.*)

Animal with a squarish, disk-like head, eyes sessile in the centre; mantle not investing; a posterior lobe; lateral lobes enveloping. (Pl.XIV. fig. 8, not 7).

ACERA, Müller.

Type, A. bullata, Pl. XIV. fig. 9. *Etym. Akeros*, hornless.

Shell thin, flexible, globosely-cylindrical, spire truncated, whirls channelled; aperture long, expanded and deeply sinuated in front, outer margin disunited at the suture; columella open, exposing the whirls.

Animal with a short and simple head-lobe, truncated in front and eyeless; lateral lobes nearly concealing the shell; lingual teeth hooked and serrulate, laterals about 40, narrow, claw-shaped; gizzard armed with horny teeth.

Distr. 7 sp. Greenland, Brit. Medit. Zanzibar, India, New Zealand.

A. bullata is found amongst weed, in 1—15 fms. water (*Forbes*).

CYLICHNA, Lovén.

Type, C. cylindracea, Pl. XIV. fig. 10. *Syn.* Bullina, Risso.

Shell strong, cylindrical, smooth or punctate-striate; spire minute or truncated; aperture narrow, rounded in front; columella callous, with one plait.

Animal short and broad, not investing the shell; head flattened, truncated in front, with sub-centrally immersed eyes, tentacular lobes more or less united; foot oblong, posterior and lateral lobes not much developed; gizzard armed; lingual teeth squarish, recurved and serrated, with 1 large and 5 or 6 small hooked laterals.

Distr. 20 sp. U. States, Greenland, Brit. Red Sea, Australia.

Fossil. Miocene —. Brit.

AMPHISPHYRA, Lovén.

Type. A. pellucida, Johnst. (*Amphi-sphyra*, double hammer.)

Syn. Utriculus (part) Brown. Rhizorus, Montf. Diaphana, Brown.

Shell small, thin, ovate, truncated, spire minute papillary, aperture long.

Animal entirely retractile into its shell; head wide, short, with lateral triangular tentacles; the eyes behind them minute, immersed; muzzle bi-lobed in front; foot oblong, truncated in front, notched behind; teeth 1.1.1, central quadrate, serrulate; laterals broad, hooked.

Distr. 5 sp. U. States, Norway, Brit. Borneo, Mexico.

APLUSTRUM, Schumacher.

Type, Bulla aplustre, Pl. XIV. fig. 11. *Etym. Aplustre*, a ship's flag.

Syn. Bullina, Fér. Hydatina (physis) Schum. Bullinula (scabra) Beck.

Shell oval, ventricose, highly coloured; spire wide, depressed; aperture truncated in front; outer lip sharp.

Animal, with a very large foot, extending beyond the shell all round, and capable of enveloping it; a posterior lobe reflected on the spire; mantle not investing; tentacular lobes large, oval, ear-shaped; labial tentacles four; eyes small, black, sessile at the inner bases of the tentacles; lingual teeth (*B. physis*) 13.0.13, serrated.

Distr. 10 sp. U. States, W. Indies, Mauritius, Ceylon, China, Australia.

SCAPHANDER, Montfort.

Type, S. lignarius, Pl. XIV. fig. 12. *Etym. Scaphe* boat, *aner,* man.

Shell oblong, convolute; spirally striated; aperture much expanded in front; spire concealed; epidermis thick; lingual teeth 1.0.1. crested.

Animal with a large oblong head, destitute of eyes; foot short and broad; lateral lobes reflected, but not enveloping the shell; gizzard of two large trigonal plates and a small narrow transverse plate (fig. 17).

Distr. 5 sp. U. States, Norway, Brit. Medit. on sandy ground; 50 fms.

Fossil, 8 sp. Eocene —. Brit. France.

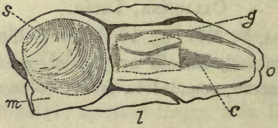

Fig. 104. *Bullæa aperta.**

BULLÆA, Lamarck.†

Type, B. aperta, Pl. XIV. fig. 13.

Shell internal, white, translucent, oval, slightly convoluted, spire rudimentary.

Animal pale, slug-like; mantle investing the shell; head oblong; eyeless; foot broad; lateral lobes large, but not enveloping; tongue with 2 or 4 series of sickle-shaped *uncini*; gizzard with 3 longitudinal shelly plates. Egg capsules ovate, in single series on a long spiral thread; fry with a ciliated head-veil and an operculated, spiral shell, (*Lovén*).

Distr. 10 sp. W. Indies, Greenland, Norway, Britain, Medit. Corea, Borneo. *Fossil,* Eocene —. France.

Sub-genus, Chelidonura, A. Adams, (Hirundella, Gray) B. hirundinaria, Quoy, Mauritius. *Shell* concealed; outer lip produced posteriorly into a spur; columellar border inflected. *Animal* with enveloping side lobes; mantle with two appendages behind, like the lateral processes of *Hyalaea.*

DORIDIUM, Meckel.

Etym. diminutive of *Doris.* *Syn.* Acera, Cuv. Eidothea, Risso.

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* From a specimen dredged at Folkstone; *o*, mouth, *c*, head, or cephalic disk, *l*, side-lobes of the foot, *m*, mantle, The shell *s*, and gizzard *g*, are indistinctly seen through the translucent integuments.

† Gray adopts the pre-Linnean name *Philine* (Ascanius, 1762), and D'Orbigny the still older *Lobaria,* (Müller, 1741), names given to particular *species*, and not to *genera* as now understood.

Type, D. membranaceum, Meck. Medit.

Animal oblong, truncated behind, the angles produced and dilated or filiform; head ovate-oblong, retuse in front; side-lobes expanded, wing-like; mantle investing a rudimentary, membranous shell.

GASTROPTERON, Meckel.

Type, G. Meckelii, Bl. (Clio amate, Chiaje) Medit.

Animal shell-less, oval, with side-lobes developed into wing-like expansions meeting and uniting behind; cephalic disk triangular, obtuse in front, pointed behind, eyes centrally immersed; lingual teeth 5.1.5.; mantle? branchial plume exposed on the right side; reproductive orifice in front of the gill, excretory opening behind it. Lon. 1, lat. 2 inches.

Sormetus Adansonii, Bl. is described as semi-cylindrical, with sides grooved, head indistinct; shell unguiform, thin, and transparent.

Atlas (*Peronii*, Bl.) Lesueur. Head with 2 small tentacular lobes; body contracted in the middle; foot dilated circularly, and fringed at the margin.

FAMILY III. APLYSIADÆ.

Shell wanting, or rudimentary and covered by the mantle, oblong, trigonal, or slightly convoluted.

Animal slug-like, with distinct head, tentacles and eyes; foot long, drawn out into a tail behind; sides with extensive lobes, reflected over the back and shell; branchial plume concealed. Sexes united.

APLYSIA, Gmelin. Sea Hare.

Type. A. depilans, Pl. XIV. fig. 14. *Syn*. Siphonotus (geographicus) Ad.

Shell oblong, convex, flexible and translucent, with a posterior slightly incurved apex.

Animal oval, with a long neck and prominent back; head with 4 tentacles, dorsal pair ear-like with eyes at anterior lateral bases; mouth proboscidiform, with horny jaws, lingual teeth 13.1.13, hooked and serrated, about 30 rows; gizzard armed with horny spines; sides with ample lobes folding over the back, and capable of being used for swimming; gill in the middle of the back, covered by the shell, and by a lobe of the mantle which is folded posteriorly to form an excretory siphon.

Distr. 40 sp. W. Indies, Norway, Brit. Medit. Mauritius, China.

The Sea-hares are mixed feeders, living chiefly on sea-weed, but also devouring animal substances; they inhabit the laminarian zone, and oviposit amongst the weed in spring, at which time they are frequently gregarious (*Forbes*). They are perfectly harmless animals and may be handled with impunity. When molested they discharge a violet fluid from the edge of the internal surface of the mantle, which does not injure the skin, has but a faint smell, and changes to wine-red (*Goodsir*). In old times they were objects of superstitious dread, on account of their grotesque forms, and the imaginary properties of their fluid, which was held to be poisonous and to produce indelible stains.*

Fossil: one or two shells of the newest tertiary in Sicily have been doubtfully referred to this genus.

Sub-genus, Aclesia (dolabrifera) Rang. *Shell* trapeziform. Side-lobes closely enveloping the body, leaving only a small dorsal respiratory opening, surface ornamented with filaments. W. Indies.

DOLABELLA, Lamarck.

Type. D. Rumphii, Pl. XIV. fig. 15. *Etym. Dolabella,* a small hatchet.

Shell hard, calcarious, trigonal, with a curved and callous apex.

Animal like Aplysia, with gill near posterior extremity of the body and lateral crests closely appressed, leaving only a narrow opening; ornamented with branching filaments.

Distr. 12 sp. Medit. Mauritius, Ceylon, Society Ids. Sandwich Ids.

NOTARCHUS, Cuvier.

Type. N. Cuvieri, Bl. *Etym. Notos,* the back, *archos* vent.

Syn. Busiris (griseus) Risso, ? Bursatella (Leachii) Bl.

Animal shell-less, ornamented with filaments, sometimes dendritic, foot narrow, linear, lateral crests united, leaving only a narrow branchial slit; gills not covered by an opercular mantle lobe.

Distr. 4 sp. Medit. Red Sea.

ICARUS, Forbes, 1843.

Type. I. Gravesii, F. *Syn. Lophocercus* (Sieboldtii) Krohn, 1847.

Shell like Bullæa; convoluted, thin, ovate, covered with epidermis, outer lip separated at the suture, posterior angle inflected and rounded.

Animal slender, papillose; tentacles 2, ear-shaped; eyes sessile on sides of head; side-lobes reflected and partly covering the shell, united behind; tail long and pointed.

LOBIGER, Krohn.

Type, L. Philippii, Pl. XIV. fig. 16. Sicily.

Shell oval, transparent, flexible, slightly convoluted; covered with epidermis.

Animal slender, papillose, with 2 flattened, oval tentacles, and minute sessile eyes on the sides of the head; shell exposed on the middle of the back, covering the plume-like gill; sides with two pairs of rounded, dilated lobes, or natatory appendages, foot linear, tail long and slender.

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* *Aplysia,* (from *a* and *pluo*) un-washable; the *Aplysia* of the Greek Fishermen were sponges unfit for washing!

FAMILY IV. PLEUROBRANCHIDÆ.

Shell limpet-like or concealed, rarely wanting; mantle or shell covering the back of the animal; gill lateral, between the mantle-margin and foot; food vegetable, stomach extremely complicated.

PLEUROBRANCHUS, Cuvier.

Ex. P. membranaceus, Pl. XIV. fig. 17. *Etym. Pleura* side, *branchia* gill.

Syn. Berthella (plumula) Bl. Oscanius (membr.) Gray.

Shell internal, large, oblong, flexible, slightly convex, lamellar, with a posterior, subspiral nucleus.

Animal oblong, convex; mantle covering the back and sides, papillated, containing spicula; foot large, separated from the mantle by a groove; gill single, free at the end, placed on the right side between the mantle and foot; orifices near the base of the gill; head with 2 grooved tentacles, eyes at their outer bases; mouth armed with horny jaws and covered by a broad veil with tentacular lobes.

Distr. 20 sp. S. America, Norway, Brit. Medit. Red Sea.

Sub-genus ? Pleurobranchæa Meckel; P. Meckelii, Leve, Medit. *Syn.* Pleurobranchidium (maculatum) Quoy, S. Australia. Mantle-margin very narrow, not concealing the gill; dorsal tentacles ear-like, oral veil tentaculiform.

POSTEROBRANCHÆA, D'Orbigny.

Type, P. maculata, D'Orb. Coast of Chile.

Animal shell-less; oval, depressed, covered by a mantle broader than the foot; foot oblong, bi-lobed behind; branchial plume on the left side, projecting posteriorly; reproductive orifice in front of gill, excretory behind; proboscis covered by a broad bi-lobed veil; no dorsal tentacles.

RUNCINA, (Forbes) Hancock.

Type, R. Hancocki, Forbes. *Syn.* ? Pelta, Quatr. (not Beck.)

Animal minute, slug-like, with a distinct mantle; eyes sessile on the front part of the mantle; no tentacles; gills 3, slightly plumose, placed with the vent on the right side, at the hinder part of the back, beneath the mantle; gizzard armed; reproductive organs on the right side.

Distr. on *Confervæ* near high-water mark, Torbay.

UMBRELLA, Chemnitz. Chinese-umbrella shell.

Type, U. umbellata, Pl. XIV. fig. 18. *Syn.* Acardo, Lam. Gastroplax, Bl.

Shell limpet-like, orbicular, depressed, marked by concentric lines of growth; apex sub-central, oblique, scarcely raised; margins acute; inner surface with a central coloured and striated disk, surrounded by a continuous irregular muscular impression.

Animal with a very large tuberculated foot, deeply notched in front; mouth small, proboscidiform, retractile into the pedal notch, covered by a small lobed veil; dorsal tentacles ear-shaped, with large plicated cavities at their bases; eyes small, sessile between the tentacles; mantle not extending beyond the shell; gill forming a series of plumes beneath the shell in front and on the right side; reproductive organ in front of the dorsal tentacles; excretory orifice posterior, tubular.

Distr. 3 sp. Canaries, Medit. India, China, Sandwich Ids.

Fossil 2 sp. Eocene —. U. States, Sicily.

TYLODINA, Rafinesque.

Type, T. punctulata, Raf. (= citrina, Joannis) 3 sp. Medit. Norway.

Shell limpet-like, depressed, apex sub-central, with a minute spiral nucleus.

Animal oblong, foot truncated in front, rather pointed behind; dorsal tentacles ear-like, with eyes sessile at their inner bases; oral tentacles broad; branchial plume projecting posteriorly on the right side.

FAMILY V. PHYLLIDIADÆ.

Animal shell-less, covered by a mantle, branchial laminæ arranged in series on both sides of the body, between the foot and mantle. Sexes united.

PHYLLIDIA, Cuvier.

Type, P. pustulosa, Cuv. *Etym.* Diminutive of *Phyllon,* a leaf.

Animal oblong, covered with a coriaceous tuberculated mantle; dorsal tentacles clavate, retractile into cavities near the front of the mantle; mouth with two tentacles; foot broadly oval; gills forming a series of laminæ extending the entire length of both sides; excretory orifice in the middle line, near the posterior end of the back, or between the mantle and foot; reproductive organs on the right side; stomach simple, membranous.

Distr. 4 sp. Medit. Red Sea, India.

DIPHYLLIDIA, Cuvier.

Type, D. Brugmansii, Cuv. *Syn.* Pleurophyllidia, Chiaje. Linguella, Bl.

Animal oblong, fleshy; mantle ample; gills limited to the hinder two-thirds of the body; head with minute tentacles and a lobe-like veil; vent at the right side, behind the reproductive orifices; lingual teeth 30.1.30.

Distr. 4 sp. Norway, Brit. (*D. lineata,* Otto) Medit.

SECTION B. NUDIBRANCHIATA.

Animal destitute of a shell except in the embryo state; branchiæ always external, on the back or sides of the body; sexes united.

The Nudibranchiate sea-slugs are found on all coasts where the bottom is firm or rocky, from between tide-marks to a depth of 50 fathoms; a few species are pelagic, crawling on the stems and fronds of floating sea-weed. They have been found by Middendorff, in the Icy Sea, at Sitka, and in the sea of Ochotsk; in the tropical and southern seas they are abundant. No satisfactory account, however, has been published of any except the European, and especially the British species, which form the subject of an admirable monograph by Messrs. Alder and Hancock, in the transactions of the Ray Society. They require to be watched and drawn whilst living and active, since after immersion in spirits they lose both their form and colour. In some the back is covered with a *cloak* or mantle (?) which contains calcarious spicula of various forms, sometimes so abundant as to form a hard shield-like crust.* The dorsal tentacles and gills pass through holes in the cloak somewhat like the "key-hole" in *Fissurella.* In others there is no trace of a mantle whatever. The eyes appear as minute black dots, immersed in the skin, behind the tentacles; they are well organized, and conspicuous in the young, but often invisible in the adult. The dorsal tentacles are laminated, like the antennæ of many insects (fig. 11, p. 23); they are never used as organs of touch, and are supplied with nerves from the olfactory ganglia. The nervous centres are often conspicuous by their bright orange colour; they are concentrated *above* the œsophagus; three pairs are larger than the rest, the *cerebroid* in front, the *branchial* behind, and the *pedal* ganglia at the sides. The cerebroid supplies nerves to the tentacles, mouth, and lips.

The *olfactory* ganglia are sessile on the front of the cerebroid (in *Doris*) or situated at the base of the tentacles (in *Æolis*). The *optic* ganglia are placed on the posterior border of the cerebroid; the auditory capsules are sessile on the cerebroid, immediately behind the eyes, they contain an agglomeration of minute *otolites* which are continually oscillating.† The *buccal* ganglia are below the œsophagus, united to the cerebroid by commissures, forming a ring; anterior to this a small ring is sometimes formed by the union of the 5th pair of nerves. The *pedal* ganglia (properly infra-œsophageal) are united laterally to the cerebroid and rarely meet below, but are united by commissures which form (together with those of the branchial centres) the 3rd ring, or *great nervous collar*. The *branchial* ganglia are united behind to the cerebroid, and sometimes blend with them; they supply the skin of the back, the rudimentary mantle, and the gills; beneath, and sessile on their front border is the single *visceral* ganglion. Besides this *excito-motory* system, (which includes the great centres, or brain, and the nerves of sensation and voluntary motion), the nudibranches possess a *sympathetic* system, consisting of innumerable minute ganglia, dotted over all the viscera, united by nerves forming plexuses, and connected in front with the buccal and branchial centres.‡

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* According to Mr. Huxley, the "cloak" of the Dorids is not the equivalent of the *mantle*, but "has more relation to the *epipodium*."

† The auditory capsules of other Mollusca (excepting the Nucleobranches) are attached to the posterior side of the pedal (sub-œsophageal) ganglia.

‡ The *sympathetic system* supplies nerves to the heart and other organs which are independent of the will, and not ordinarily susceptible of pain; they are called "organic" nerves, as all the *vegetative* functions depend on them. Its existence in the

The digestive organs of the Nudibranches present two remarkable modifications: in *Doris* and *Tritonia* the liver is compact and the stomach a simple membranous sac; whilst in *Æolis* the liver is disintegrated, and its canals so large that the process of digestion must be chiefly carried on in them, and they are regarded as cœcal prolongations of the stomach; the cœca extend into a series of gill-like processes, arranged upon the back of the animal, which also contain part or the whole of the true liver; the gastric ramifications vary exceedingly in amount of complexity.

The vascular system and circulation of the nudibranchiate molluscs is incomplete. In *Doris* veins can be traced only in the liver and skin; the greater part of the blood from the arteries escapes into the visceral sinus and into a net-work of sinuses in the skin, from which it returns to the auricle by two lateral veins, without having circulated through the gills. The heart is contained in a *pericardium* to which is attached a small ventricle, or *portal* heart, for impelling blood to the liver; the hepatic veins run side by side with the arteries and open into a circular vein, surrounding the vent, and supplying the gills. Only hepatic blood, therefore, circulates through the gills. In *Æolis* there are no special gills, but the gastro-hepatic papillæ are accompanied by veins which transmit blood to the auricle. The skin acts as an accessory breathing-organ; it performs the function entirely in the *Elysiadæ*, and in the other families when by accident the branchiæ are destroyed. The water on the gills is renewed by ciliary action. The fry is provided with a transparent, nautiloid shell, closed by an operculum, and swims with a lobed head-veil fringed with cilia, like the young of most other gasteropods.—*Hancock* and *Embleton*, Phil. Trans. 1852. An. Nat. Hist. 1843.

FAMILY VI. DORIDÆ.* Sea-lemons.

Animal oblong; gills plume-like, placed in a circle on the middle of the back; tentacles two; eye-specks immersed, behind the tentacles, not always visible in the adult; lingual membrane with usually numerous lateral teeth, rachis often edentulous; stomach simple; liver compact; skin strengthened with spicula, more or less definitely arranged.

DORIS, L.

Etym. Doris, a sea-nymph. *Ex.* D. Johnstoni, Pl. XIII. fig. 1.

Animal oval, depressed; mantle large, simple, covering the head and foot; dorsal tentacles 2, clavate or conical, lamellated, retractile within

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Mollusca was first clearly demonstrated by M.M. Hancock and Embleton. The *excito-motory* system of the Mollusca corresponds with the *cerebro-spinal* system of the vertebrata.

[*] Contracted from *Dorididæ;* as the Greeks used Deucalides for *Deucaliontiades.* Ehrenberg divided the genus Doris into sections, by the number and form of the gills, characters of only specific importance.

cavities; gills surrounding the vent on the posterior part of the back, retractile into a cavity; head with an oral veil, sometimes produced into labial tentacles; mouth with a lower mandible, consisting of two horny plates, united near the front, and having 2 projecting points; lingual teeth numerous, central small, laterals similar, hooked and sometimes serrated (24-68 rows; 37-141 in a row; nidamental ribbon rather wide, forming a spiral coil of few volutions (p. 50, fig. 29.)

Sub-genus, *Oncidoris* (Bl. ?). D. bilamellata, Johnst. Back elevated, tuberculose; gills non-retractile; oral tentacles fused into a veil; buccal mass with a gizzard-like appendage; lingual teeth 2 in each row. (A. and H.)

D. scutigera (*Villiersia*) D'Orb. Rochelle; has the mantle more than usually strengthened with calcarious spicula.

The Dorids vary in length from 3 lines to more than 3 inches; they feed on zoophytes and sponges, and are most plentiful on rocky coasts, near low-water, but range as low as 25 fms. They occur in all seas, from Norway to the Pacific.

GONIODORIS, Forbes.

Etym. *Gonia*, an angle. *Type*, G. nodosa, Pl. XIII. fig. 2.

Animal oblong; tentacles clavate, laminated, non-retractile; mantle small, simple, exposing the head and foot. Spawn coiled irregularly.

Distr. Norway, Brit. (2 sp.) Medit. China. Between tide-marks.

TRIOPA, Johnston.

Type, T. clavigera, Pl. XIII. fig, 3. *Syn*. Psiloceros, Menke.

Animal oblong; tentacles clavate, retractile within sheaths; mantle margined with filaments; gills few, pinnate, around or in front of the dorsal vent. (A. and H.) Lingual teeth 8.1.8, or 8.0.8.

Distr. Norway, Brit. Low-water — 20 fms.

ÆGIRUS, Lovén.

Type, A. punctilucens, Pl. XIII. fig. 4. *Etym*. ? *Aix* (*aigos*) a goat.

Animal oblong or elongated, covered with very large tubercles; no distinct mantle; tentacles linear, retractile within prominent lobed sheaths; gills dendritic, placed around the dorsal vent. (A. and H.) Lingual teeth 17.0.17.

Distr. Norway, Brit. (2 sp.) France. Litoral zone.

THECACERA, Fleming.

Etym. *Theke* a sheath, *ceras* a horn. *Type*, T. pennigerum, Mont.

Animal oblong, smooth; tentacles clavate, laminated, retractile within sheaths; head with a simple frontal veil; gills pinnate, placed round the dorsal vent, and surrounded by a row of tubercles. (A. and H.)

Distr. Brit. 2 sp. Lon. $\frac{1}{4}$—$\frac{1}{2}$ inch. Found at low-water.

POLYCERA, Cuvier.

Etym. *Polycera*, many horns. *Type*, P. quadrilineata, Pl. XIII. fig. 5.

Animal oblong or elongated; tentacles laminated, non-retractile, sheathless; head-veil bordered with tubercles or tentacular processes; gills with 2 or more lateral appendages. (A. and H.)

Distr. Norway, 5 sp. Brit. Red Sea. Within tide-marks and in deep water on corallines. The spawn is strap-shaped, and coiled on stones, in July and August. P. ocellata (*Plocamophorus*, Rüppell) has the cephalic tentacles branched.

IDÀLIA, Leuckart.

Etym. Idalia, Venus, from Mt. Idalium in Cyprus.

Syn. Euplocamus, Phil. Peplidium (Maderæ) Lowe.

Ex. I. aspersa, Pl. XIII. fig. 6. Coralline zone.

Animal broadly oblong, nearly smooth, tentacles clavate or linear, with filaments at their base; head slightly lobed at the sides; mantle very small, margined with filaments; lingual teeth 2.0.2.

Distr. Norway, Brit. (4 sp.) Medit. Madeira.

ANCULA, Lovén.

Syn. Miranda, A. and H. *Type*, A. cristata, Alder.

Animal slender, elongated; mantle entirely adnate, ornamented with simple filaments; tentacles clavate, laminated; with filiform appendages at their base; labial veil produced on each side.

Distr. Norway, Brit. Lon. ½ inch.

CERATOSOMA (Gray), A. Adams.

Etym. Ceratois, horned, *soma,* body. *Type,* C. cornigerum, Ad.

Animal oblong, narrow, with two large and prominent horn-like processes on the posterior part of the back, behind the gills; gills 5, bipinnate; dorsal tentacles clavate, laminated, rising from rounded tubercles, non-retractile; head with short lateral processes: foot narrow.

Distr. Sooloo sea. (A. Adams.)

FAMILY VII. TRITONIADÆ.

Animal with laminated, plumose, or papillose gills, arranged along the sides of the back; tentacles retractile into sheaths; lingual membrane with 1 central and numerous lateral teeth; orifices on the right side.

TRITONIA, Cuvier.

Ex. T. plebeia, Pl. XIII. fig. 7.

Animal elongated; tentacles with branched filaments; veil tuberculated or digitated; gills in single series on a ridge down each side of the back; mouth armed with horny jaws; stomach simple; liver compact.

Distr. Norway, Brit. Under stones at low-water, — 15 fm. F. Hombergii, Cuv. found on the scallop-banks, attains a length exceeding 6 inches.

SCYLLÆA, L.

Type, S. pelagica, Pl. XIII. fig. 8. *Etym. Scyllaea*, a sea-nymph.

Animal elongated, compressed; foot long, narrow and channelled, adapted for clasping sea-weed; back with 2 pairs of wing-like lateral lobes, bearing small tufted branchiæ on their inner surfaces; tentacles dorsal, slender, with lamellated tips, retractile into long sheaths; lingual teeth 24.1.24, denticulated; gizzard armed with horny, knife-like plates; orifices on the right side.

Distr. Atlantic, S. Brit. Medit. On floating sea-weed.

Nerea (punctata) Lesson, New Guinea; 10 lines long, with ear-shaped tentacles, and 3 pairs of dorsal lobes.

TETHYS, L.

Etym. Tethys, the sea (personified.) *Syn.* Fimbria, Bohadsch.

Type, T. fimbriata, L. Pl. XIII. fig. 9.

Animal elliptical, depressed; head covered by a broadly expanded, fringed disk, with 2 conical tentacles, retractile into foliaceous sheaths; gills slightly branched, a single row down each side of the back; reproductive orifices behind first gills, vent on right side, behind second gill; stomach simple.

Distr. 1 sp. Medit. Attains a foot in length, and feeds on other molluscs and crustaceans. (*Cuvier.*)

? BORNELLA (Gray), A. Adams.

Type, A. Adamsii, Gray. *Lon.* 4 inches.

Animal elongated; dorsal tentacles retractile into branched sheaths; head with stellate processes; back with two rows of cylindrical, branched, gastric processes, to which small dendritic gills are attached;* foot very narrow.

Distr. 2 sp. Straits of Sunda, on floating weed; Borneo.

? DENDRONOTUS, A. and H.†

Etym. Dendron, a tree, *notos,* the back.

Type, D. arborescens, Pl. XIII. fig. 10.

Animal elongated; tentacles laminated; front of the head with branched appendages; gills arborescent, in single series down each side of the back; foot narrow; lingual teeth 10.1.10; stomach and liver ramified.

Distr. Icy sea; Norway, Brit. On sea-weed and corallines; low-water—coralline zone.

? DOTO, Oken.

Etym. Doto, a sea-nymph. *Ex.* D. coronata, Pl. XIII. fig. 11.

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* This observation deserves further enquiry.

† This and the following genera are placed by Alder and Hancock in the family *Æolidæ;* they have a ramified stomach, but their external (*zoological*) characters agree better with *Tritonia* than *Æolis.*

Animal slender, elongated; tentacles linear, retractile into trumpet-shaped sheaths; veil small, simple; gills ovate, muricated, in single series down each side of the back; lingual membrane slender, with above 100 recurved, denticulated teeth, in single series; foot very narrow.

The stomach is ramified, and the liver is entirely contained in the dorsal processes, which fall off readily when the animal is handled, and are soon renewed.

Distr. Norway, Brit. On corallines in deep water — 50 fms.

? MELIBŒA, Rang.

Type, M. rosea, Rang; on floating weed, off the Cape.

Animal elongated, with a narrow, channelled foot and long slender tail; sides of the back with 6 pairs of tuberculated lobes, easily deciduous; tentacles cylindrical, retractile into long trumpet-shaped sheaths; head covered by a lobe-like veil; sexual orifices behind right tentacle, excretory behind first gill on the right side.

? LOMANOTUS, Verany.

Ex. L. marmoratus, Pl. XIII. fig. 12. *Syn.* Eumenis, A. and H.

Animal elongated, smooth; head covered with a veil; tentacles clavate, laminated, retractile into sheaths; gills filamentose, arranged along the sides of the back, on the wavy margins of the mantle; foot narrow, with tentacular processes in front; stomach ramified.

Distr. Brit. Medit. On corallines.

FAMILY VIII. ÆOLIDÆ.

Animal with papillose gills, arranged along the sides of the back; tentacles sheath-less, non-retractile; lingual teeth 0.1.0.; ramifications of the stomach and liver extending into the dorsal papillæ; excretory orifices on the right side; skin smooth, without spicula; no distinct mantle.

ÆOLIS, Cuvier.

Syn. Psiloceros, Menke. Eubranchus, Forbes. Amphorina, Quatref.

Type, Æ. papillosa, L. *Etym.* *Æolis,* daughter of Æolus.

Animal ovate; dorsal tentacles smooth, oval, slender; gills simple, cylindrical, numerous, depressed and imbricated; mouth with a horny upper jaw, consisting of two lateral plates, united above by a ligament; foot narrow; tongue with a single series of curved, pectinated teeth; spawn of numerous waved coils.

Sub-genera. *Flabellina,* Cuv. (Phyllodesmium, Ehr.) Body slender; dorsal tentacles laminated, buccal long; papillæ clustered; spawn multi-spiral. *Ex.* E. coronata, Pl. XIII. fig. 13. (also fig. 11, p. 23.)

Cavolina, Brug. (Montagua, Flem.) C. peregrina. Body lanceolate; tentacles smooth or wrinkled; papillæ in transverse, rather distant rows; spawn of 1 or 2 coils.

Tergipes, Cuv. T. lacinulata. Body linear; tentacles smooth; papillæ in a single row on each side; spawn kidney-shaped.

Distr. Norway, Brit. (33 sp.) U. States, Medit. S. Atlantic, Pacific. Found amongst rocks, at low-water; they are active animals, moving their tentacles continually, and extending and contracting their papillæ; they swim readily at the surface, inverted. They feed chiefly on sertularian zoophytes, and if kept fasting will devour each other; when irritated they discharge a milky fluid from their papillæ, which are very liable to fall off.

Glaucus, Forster.

Etym. *Glaucus*, a sea-deity. *Syn.* Laniogerus, Bl. Pleuropus, Raf.

Ex. G. Atlanticus, Pl. XIII. fig. 14.

Animal elongated, slender: foot linear, channelled; tentacles 4, conical; jaws horny; teeth in single series, arched and pectinated; gills slender, cylindrical, supported on 3 pairs of lateral lobes; stomach giving off large cœca to the tail and side lobes; liver contained in the branchial papillæ; sexual orifice beneath first dextral gill, vent behind second gill; spawn in a close spiral coil.

Distr. 6 sp. Atlantic, Pacific. Found on floating sea-weed; devours small sea-jellies, *Porpitæ* and *Velellæ*. (Bennet.)

Fiona, Alder and Hancock.

Type, F. nobilis, A. and H. *Syn.* Oithona, A. and H. (not Baird).

Animal elongated; oral and dorsal tentacles linear; mouth armed with horny jaws; gills papillary, clothing irregularly a sub-pallial expansion on the sides of the back, each with a membranous fringe running down its inner side.

Distr. Falmouth. Under stones at low-water. (Dr. Cocks.)

Embletonia, A. and H.

Etym. Dedicated to Dr. Embleton, of Newcastle.

Syn. Pterochilus, A. and H. ? Clœlia (formosa) Loven.

Type, E. pulchra, Pl. XIII. fig. 15.

Animal slender; tentacles 2, simple; head produced into a flat lobe on each side; papillæ simple, subcylindrical, in a single row down each side of the back.

Distr. Scotland (2 sp.) In the litoral and laminarian zones.

Calliopæa (bellula) D'Orb. Brest; has 2 rows of papillæ down each side of the back; cephalic lobes subulate; vent dextral. Lon. 3 lines.

Proctonotus, A. and H.

Type, P. mucroniferus, Pl. XIII. fig. 16. Dublin, shallow water.

Syn. Venilia, A. and H. Zephrina, Quatref.

Animal oblong, depressed, pointed behind; dorsal tentacles 2, linear, simple, with eyes at their base, behind; oral tentacles short; head covered by a small semilunar veil; mouth with horny jaws; gills papillose, on ridges down the sides of the back, and round the head in front; vent dorsal.

ANTIOPA, A. and H.

Type, A. splendida, A. and H. *Syn.* Janus, Verany.

Animal ovate-oblong, pointed behind; dorsal tentacles lamellated, united at the base by an arched crest; head with a small veil and two labial tentacles; gills ovate, placed along the lateral ridges of the back and continuous above the head; vent central, posterior, sexual orifice at the right side; lingual teeth numerous. ?

Distr. Brit. Medit.

HERMÆA, Lovén.

Type, H. bifida, Pl. XIII. fig. 17. Norway, Brit.

Animal elongated, tentacles folded longitudinally; gills numerous, papillose, arranged down the sides of the back; sexual orifice below right tentacles; vent dorsal, or sub-lateral, anterior.

ALDERIA, Allman.

Etym. Named after Joshua Alder, one of the authors of the Monograph on the British Nudibranchiate Mollusca.

Type, A. modesta, Pl. XIII. fig. 18. Norway, S. Ireland and S. Wales.

Animal oblong, without tentacles; head lobed at the sides; gills papillose, arranged down the sides of the back; vent dorsal, posterior.

? *Stiliger* (ornatus) Ehrenberg; Red Sea. Vent dorsal, anterior.

FAMILY IX. PHYLLIRHOIDÆ.

Animal pelagic, foot-less (*apodal*), compressed, swimming freely with a fin-like tail; tentacles 2, dorsal; no branchiæ; lingual teeth in a single series; stomach furnished with elongated cœca; orifices on the right side; sexes united.

PHYLLIRHOE, Péron and Lesueur.

Etym. Phyllon, a leaf, *rhoë*, the wave. *Syn.* Eurydice, Esch.

Type, P. bucephala, Péron. *Distr.* 6 sp. Medit. Moluccas, Pacific.

Animal translucent, fusiform, with a lobed tail; muzzle round, truncated; jaws horny; lingual teeth 3.0.3.; tentacles long and slender, with short sheaths; intromittent organ long, bifid.

FAMILY X. ELYSIADÆ.

Animal shell-less, limaciform, with no distinct mantle or breathing organ; respiration performed by the ciliated surface of the body; mouth armed with a single series of lingual teeth; stomach central, vent median, sub-central; hepatic organs branched, extending the length of the body and opening into the sides of the stomach; sexes united; male and ovarian orifices below the right eye; female orifice in the middle of the right side; heart with an auricle behind, and traces of an arterial and venous system, eyes sessile on the sides of the head, tentacles simple or obsolete.*

ELYSIA, Risso.

Type, E. viridis, Pl. XIII. fig. 19. *Syn.* Actæon, Oken.

Animal elliptical, depressed, with wing-like lateral expansions; tentacles simple, with sessile eyes behind them; foot narrow.

Distr. Brit. Medit. On *Zostera* and sea-weed, in the laminarian zone. *Placo-branchus* (ocellatus, Rang.) Hasselt, Java; described as 2 inches long, with four small tentacles; the lateral expansions much developed and meeting behind, the upper surface longitudinally plaited, and forming, when the side-lobes are rolled together, a sort of branchial chamber.

ACTEONIA, Quatrefages.

Ex. A. corrugata, Pl. XIII. fig. 20. British channel.

Animal minute, leach-like; head obtuse, with lateral crests proceeding from two short conical tentacles, behind which are the eyes.

CENIA, Alder and Hancock.

Type, C. Cocksii, Pl. XIII. fig. 21. *Etym. Cenia,* Falmouth.

Syn. ? Fucola (rubra) (Quoy).

Animal limaciform, back elevated, head slightly angulated, bearing two linear dorsal tentacles, with eyes at their outer bases behind.

LIMAPONTIA, Johnston.

Type, L. nigra, Pl. XIII. fig. 22. *Syn.* Chalidis, Qu. Pontolimax, Cr.

Animal minute, leach-like; head truncated in front, with arched lateral ridges on which are the eyes; foot linear.

Distr. Norway, England and France, between half-tide and high-water, feeding on *Confervæ,* in the spring and summer; spawn in small pear-shaped masses, each with 50-150 eggs; fry with a transparent nautiloid shell, closed by an operculum.

ORDER IV. NUCLEOBRANCHIATA. Bl.†

The present order consists entirely of pelagic animals, which swim at the surface, instead of creeping on the bed of the sea. Their rank and affinities entitle them to the first place in the class; but their extremely aberrant form, and unusual mode of progression, have caused us to postpone their description till after that of the ordinary and typical *gasteropoda.*

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* Order *Dermi-branchiata,* Quatref. (*Pelli-branchiata,* A. and H.) M. Quatrefages erroneously described the *Elysiadæ* as wanting both heart and blood vessels, like the Ascidian zoophytes; with them he associated the family *Æolidæ,* which he described as having a heart and arteries, but no veins, their office being performed by lacunæ of the areolar tissue. In both families the product of digestion (*chyle*) was supposed to be aërated in the gastric ramifications, by the direct influence of the surrounding water. To this group, which has been since abandoned, he applied the name *Phlebenterata,* (*phlebs,* a vein, *entera,* the intestines).

† So called because the respiratory and digestive organs form a sort of *nucleus* on the posterior part of the back. See fig. 105, *s. b.*, and Pl. XIV. fig. 24.

There are two families of nucleobranchiate mollusks; the *firolas* and *carinarias,* with large bodies and small or no shells, and the *Atlantas,* which can retire into their shells and close them with an operculum. Both animal and shell are symmetrical, or nearly so; the nucleus of the shell is minute and dextrally spiral.

The *nucleobranches* swim rapidly by the vigorous movements of their fin-like tails, or by a fan-shaped ventral fin; and adhere to sea-weed by a small sucker placed on the margin of the latter. Mr. Huxley has shown that these organs represent the three essential parts of the foot in the most highly developed sea-snails. The *sucker* represents the central part of the foot, or creeping disk (*meso-podium*) of the snail and whelk; the ventral fin is homologous with the anterior division of the foot, (*pro-podium*) which is very distinct in *Natica* (p. 123), and in *Harpa* and *Oliva*; but is only marked by a groove in *Paludina* and *Dolium* (fig. 71.) The terminal fin (or tail of *Carinaria*) which carries the operculum of *Atlanta,* is the equivalent of the operculigerous lobe (*meta-podium*) of the ordinary gasteropods, such as *Strombus* (fig. 69).

The abdomen, or visceral mass, is small, whilst the anterior part of the body (or *cephalo-thorax,* M. Edw.) is enormously developed. The proboscis is large and cylindrical, and the tongue armed with recurved spines. The alimentary canal of *Firola* is bent up at a right angle posteriorly on the dorsal side; in *Atlanta* it is recurved, and ends in the branchial chamber. The heart is *proso-branchiate,* although in *Firola* the auricle is rather above than in front of the ventricle, owing to the small amount of the dorsal flexure.

The nucleobranches, and especially those without shells, "afford the most complete ocular demonstration of the truth of MILNE EDWARDS' views with regard to the nature of the circulation in the *mollusca.* Their transparency allows the blood-corpuscles to be seen floating in the general cavity of the body—between the viscera and the outer integument—and drifting backwards to the heart; having reached the wall of the auricle they make their way through its meshes as they best can, sometimes getting entangled therein, if the force of the heart has become feeble. From the auricle they may be followed to the ventricle, and thence to the aorta and pedal artery, through whose open ends they pour into the tissues of the head and fin." (*Huxley.*)

Such delicate and transparent creatures would hardly seem to need any special breathing-organ, and in fact it is present or absent in species of the same genus, and even in specimens of the same species. *Carinaria* has fully-formed branchiæ; in *Atlanta* they are sometimes distinct, and wanting in others; in *Firoloides* they are only indicated by a ciliated sub-spiral band. The larvae are furnished with a shell, and with ciliated *vela*. (Gegenbaur.)

The nucleobranches are *diœcious;* some individuals (of *Firola*) have a leaf-like appendage, others a long slender egg-tube depending from the oviduct, and regularly annulated.* The larvæ are furnished with a shell, and with ciliated *vela*. (Gegenbaur.)

The nervous system is remarkable for the wide separation of the centres. The buccal ganglia are situated considerably in front of the cephalic, and the *pedal ganglia* are far behind, so that the commissures which unite them are nearly parallel with the œsophagus. The *branchial ganglia* are at the posterior extremity of the body, as in the bivalves. The eyes are hour-glass shaped, and very perfectly organized; the auditory vesicles are placed behind, and connected with the cephalic ganglia, they each contain a round otolite, which sometimes seems to oscillate. (*Huxley.*)

FAMILY I. FIROLIDÆ.

Animal elongated, cylindrical, translucent, furnished with a ventral fin, and a tail fin used in swimming; gills exposed on the posterior part of the back, or covered by a small hyaline shell. Mouth with a circular lip; lingual membrane with few rows of teeth: central teeth transversely elongated, with 3 recurved cusps; laterals 3 on each side, the first a transverse plate with a hooked apex, 2 and 3 sickle-shaped.†

FIROLA, Peron and Lesueur.

Type, F. Coronata, Forsk. Medit. *Syn*. Pterotrachæa, Forsk.

Animal fusiform, elongated, with a long, slender, proboscidiform head; fin narrowed at the base, furnished with a small sucker; tail elongated, keeled, sometimes pinnate; nucleus prominent; branchial processes numerous, conical, slender; tentacles 4, short and conical; eyes black and distinct, protected by a rudimentary eyelid; lingual ribbon oblong. The female *firolæ* have a long moniliform oviduct. *Anops Peronii*, D'Orb. described and figured as having no head (!) was probably a mutilated *Firola*. "Such specimens are very common, and seem just as lively as the rest." (Huxley.)

Distr. 8 sp. Atlantic, Medit. Pacific.

Sub-genus, Firoloides, Lesueur. (*Cerophora*, D'Orb.) F. Desmarestii, Les. Body cylindrical; head tapering, furnished with two slender tentacles; nucleus at the posterior extremity of the body, with or without small branchial filaments; egg-tube regularly annulated; tail fin small and slender, ventral fin without a sucker. *Distr*. 6 sp. Atlantic.

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* We can only call to mind one other example of a segmented organ in the *mollusca;* viz. the penniform styles of *Teredo bipalmulata*..

† The genus *Sagitta*, Q. and G. sometimes referred to this family, is an articulate animal. (Huxley.)

Carinária, Lamarck.

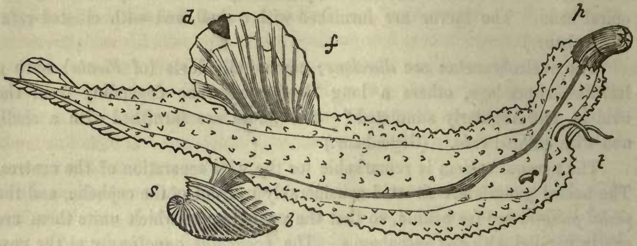

Fig. 105.*

Eym. Carina, a keel (or keeled vessel.)

Type. C. cymbium, L. fig. 105, Pl. XIV. fig. 19.

Shell hyaline, symmetrical, limpet-shaped, with a posterior sub-spiral apex and a fimbriated dorsal keel; nucleus minute, dextrally spiral.

Animal large, translucent, granulated; head thick, cylindrical; lingual ribbon triangular, teeth increasing rapidly in size, from the front backwards; tentacles long and slender, eyes near their base: ventral fin rounded, broadly attached, with a small marginal sucker; tail large, laterally compressed; nucleus pedunculated, covered by the shell, gills numerous, pinnate, projecting from beneath the shell.

Distr. 5 sp. Medit. and warmer parts of the Atlantic and Indian Oceans. They feed on small *Acalephæ,* and probably on the *pteropoda*; Mr. Wilton found in the stomach of a Carinaria two fragments of quartz rock, weighing together nearly 3 gr.

Fossil, 1 sp. Miocene. Turin.

Cardiápoda, D'Orbigny.

Ex. C. placenta, Pl. XIV. fig. 20.

Etym. Cardia, heart, *pous,* foot. *Syn.* Carinaroides, Eyd. and Souleyet.

Animal like *Carinaria. Distr.* 5 sp. Atlantic.

Shell minute, cartilaginous; peristome expanded and bi-lobed in front, enveloping the spire behind.

FAMILY II. Atlantidæ.

Animal furnished with a well-developed shell, into which it can retire; gills contained in a dorsal mantle-cavity; lingual teeth similar to *Carinaria.*

Shell symmetrical, discoidal, sometimes closed by an operculum.

Atlanta, Lesueur.

Type, A. Peronii, Pl. XIV. fig. 21-23. *Syn. Steira,* Esch.

Shell minute, glassy, compressed and prominently keeled; nucleus dextrally spiral; aperture narrow, deeply notched at the keel; operculum ovate, pointed, lamellar, with a minute, apical, dextrally spiral nucleus.

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* Fig. 105. *p.* proboscis; *t,* tentacles; *b,* branchiæ; *s,* shell; *f,* foot; *d,* disk.

Animal 3-lobed; head large, sub-cylindrical; tentacles conical, with conspicuous eyes behind them; ventral fin flattened, fan-shaped, furnished with a small fringed sucker; tail pointed, operculigerous.

Distr. 15 sp. Warmer parts of the Atlantic, Canary Ids.

Sub-genus. Oxygyrus, Benson. *Syn.* Ladas, Cantraine; Helico-phlegma, D'Orb. O. Keraudrenii, Pl. XIII. figs. 24, 25. Shell milky, narrowly umbilicated on both sides; nucleus not visible; back rounded, keeled only near the aperture; body whirl, near the aperture, and keel cartilaginous; no apertural slit; operculum trigonal, lamellar. 2 sp. Atlantic. Medit.

The *Atlanta* was discovered by Lamanon, who supposed it to be the living analogue of the Ammonite. The operculum of *Oxygyrus* (Pl. XIII. fig. 25) is singularly like the *Trigonellites* (p. 80); that of Atlanta (fig. 22) is the only example of a *dextral* operculum to a dextral shell (p. 102).

PORCÉLLIA, Léveille.

Ex. P. Puzosi, Pl. XIV. fig. 29.

Shell discoidal, many whirled; whirls keeled or coronated; nucleus spiral; aperture with a narrow dorsal slit.

Fossil, 10 sp. Devonian — Trias. Brit. Belgium.

BELLÉROPHON, Monfort.

Ex. B. bi-carinatus, Lév. Pl. XIV. fig. 27. *Syn.* Euphemus, M'Coy.

Shell symmetrically convoluted, globular, or discoidal, strong, few-whirled; whirls often sculptured; dorsally keeled; aperture sinuated and deeply notched on the dorsal side.

Fossil, 70 sp. L. Silurian — Carb. N. America, Europe, Australia. The name *Bucania* was given by Hall to the species with exposed whirls; in B. expansus, Pl. XIV. fig. 28, the aperture of the adult shell is much expanded, and the dorsal slit filled up. (*Salter.*)

Bellerophina, D'Orb (not Forbes) is founded on the *Nautilus minutus.* Sby. Pl. XIV. fig. 26, a small globular shell, spirally striated, and devoid of *septa.* It is found in the *gault* of England and France.

CYRTOLITES, Conrad.

Type, C. ornatus, Pl. XIV. fig. 30.

Etym. Kurtos, curved, *lithos,* stone.

Shell thin, symmetrical, horn-shaped or discoidal, with whirls more or less separate, keeled and sculptured.

Fossil, 13 sp. L. Silurian — Carb, N. America, Europe.

? *Ecculiomphalus* (Bucklandi) Portlock, Pl. XIV. fig. 31. L. Silurian, Brit. U. States. Shell thin, curved, or discoidal with few widely separate whirls, slightly unsymmetrical, keeled.

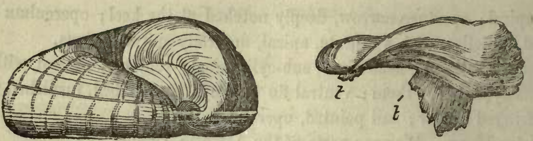

Fig. 106. *Maclurea Logani, (Salter) L. Silurian. Canada.*

? Maclurea, Lesueur.

Named after Wm. Maclure, the first American geologist.

Shell discoidal, few whirled, longitudinally grooved at the back, and slightly rugose with lines of growth; dextral side convex, deeply and narrowly perforated; left side flat, exposing the inner whirls; operculum sinistrally sub-spiral, solid, with two internal projections (*t t*) one of them beneath the nucleus, very thick and rugose.

Fossil, 5 sp. L. Silurian. N. America; Scotland (Ayrshire, M'Coy).

This singular shell abounds in the "Chazy" limestone of the U. States and Canada; sections of it may be seen even in the pavement of New York; but specimens are very difficult to obtain. We are indebted to W. E. Logan, Esq., Geological Surveyor of Canada, for the opportunity of examining a large series of silicified specimens, and of figuring a perfect shell, with its operculum *in situ*. It has more the aspect of a bivalve, such as *Requienia Lonsdalii* (Pl. XVIII. fig. 12) than of a spiral univalve, but has no hinge. Many of the specimens are overgrown with a zoophyte, generally on the convex side only, rarely on both sides.

The Maclurea has been described as *sinistral;* but its operculum is that of a dextral shell; so that the spire must be regarded as deeply sunk and the umbilicus expanded, as in certain species of *Planorbis:* unless it is a case conversely parallel to *Atlanta,* in which both shell and operculum have dextral nuclei. The affinities of *Maclurea* can only be determined by careful examination and comparison with allied, but less abnormal forms, associated with it in the oldest fossiliferous rocks; its relation to *Euomphalus* (p. 145) is not supported by the evidence of Mr. Logan's specimens.

CLASS III. PTEROPODA.

This little group consists of animals whose entire life is passed in the open sea, far away from any shelter, save what is afforded by the floating gulf-weed, and whose organization is specially adapted to that sphere of existence. In appearance and habits they strikingly resemble the fry of the ordinary sea-snails, swimming like them by the vigorous flapping of a pair of fins. To the naturalist ashore they are almost unknown; but the voyager on the great ocean meets with them where there is little else to arrest his attention, and marvels at their delicate forms, and almost incredible numbers. They swarm in the tropics, and no less in arctic seas, where by their myriads the water is discoloured for leagues (*Scoresby*). They are seen swimming at the surface in the heat of the day, as well as in the cool of the evening. Some of the larger kinds have prehensile tentacles, and their mouths armed with lingual teeth, so that, fragile as they are, they probably feed upon still smaller and feebler creatures, (*e. g. entomostraca*). In high latitudes they are the principal food of the whale, and of many sea-birds. Their shells are rarely drifted on shore, but abound in the fine sediment brought up by the dredge from great depths. A few species occur in the tertiary strata of England and the continent; in the older rocks they are unknown, unless some comparatively gigantic forms (*conularia* and *theca*) have been rightly referred to this order.

In structure, the *Pteropoda* are most nearly related to the marine univalves, but much inferior to them. Their nervous *ganglia* are concentrated into a mass *below* the œsophagus; they have auditory vesicles, containing otolites; and are sensible of light and heat and probably of odours, although at most they possess very imperfect eyes and tentacles. The true foot is small or obsolete; in *cleodora* it is combined with the fins, but in Clio it is sufficiently distinct, and consists of two elements; in *Spirialis* the posterior portion of the foot supports an *operculum.* The fins are developed from the sides of the mouth or neck, and are the equivalents of the side-lappets (*epipodia*) of the sea-snails. The mouth of *Pneumodermon* is furnished with two tentacles supporting miniature suckers; these organs have been compared with the dorsal arms of the cuttle-fishes, but it is doubtful whether their nature is the same.* A more certain point of resemblance is the ventral flexure of the alimentary canal, which terminates on the under surface, near the right side of the neck. The pteropods have a muscular gizzard, armed with gastric teeth; a liver; a pyloric cœcum; and a contractile renal organ opening into the cavity of the mantle. The heart consists of an auricle and a ventricle, and is essentially *opistho-branchiate,* although sometimes affected by the general flexure of the body. The venous system is extremely incomplete. The respiratory organ, which is little more than a *ciliated surface,* is either situated at the extremity of the body and unprotected by a mantle, or included in a branchial chamber with an opening in front. The shell, when present, is symmetrical, glassy, and translucent, consisting of a dorsal and a ventral plate united, with an anterior opening for the head, lateral slits for long filiform processes of the mantle, and terminated behind in one or three points; in other cases it is conical, or spirally coiled and closed by a spiral operculum. The sexes are united, and the orifices situated on the right side of the neck. According to Vogt, the embryo Pteropod has deciduous *vela,* like the sea-snails, before the proper locomotive organs are developed (*Huxley*).

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* The figures of Eydoux and Souleyet represent them as being supplied with nerves from the *cephalic ganglia;* whereas the arms of the cuttle-fish, and all other parts or modifications of the foot, in the *mollusca,* derive their nerves from the *pedal ganglia* (Huxley).

From this it would appear that while the Pteropoda present some analogical resemblances to the *Cephalopoda*, and permanently *represent* the larval stage of the sea-snails, they are developed on a type sufficiently peculiar to entitle them to rank as a distinct group; not indeed of equal value with the *Gasteropoda*, but with one of its orders.

This group, the lowest of the univalve or encephalous orders, makes no approach towards the bivalves or *acephala*. Forskahl and Lamarck indeed compared *Hyalæa* with *Terebratula ;* but they made the ventral plate of one answer to the dorsal valve of the other, and the anterior cephalic orifice of the pteropodous shell, correspond with the *posterior*, byssal foramen of the bivalve!

SECTION A. THECOSOMATA, Bl.*

Animal, furnished with an external shell; head indistinct: foot and tentacles rudimentary, combined with the fins; mouth situated in a cavity formed by the union of the locomotive organs; respiratory organ contained within a mantle-cavity.

FAMILY I. HYALEIDÆ.

Shell straight or curved, globular or needle-shaped, symmetrical.

Animal with two large fins, attached by a columellar muscle passing from the apex of the shell to the base of the fins; body inclosed in a mantle; gill represented by a transversely plaited and ciliated surface, within the mantle cavity, on the *ventral* side; lingual teeth (of *Hyalea*) 1.1.1, each with a strong recurved hook.

HYÁLEA, Lamarck.

Etym. Hyalĕos, glassy. *Syn.* Cavolina, Gioeni not Brug.

Type, H. tridentata, fig. 107. Pl. XIV. fig. 32.

Shell globular, translucent; dorsal plate rather flat, produced into a hood; aperture contracted, with a slit on each side; posterior extremity tridentate. In H. trispinosa (*Diacria*, Gray) the lateral slits open into the cervical aperture.

Animal, with long appendages to the mantle, passing through the lateral slits of the shell; tentacles indistinct; fins united by a semicircular ventral lobe, the equivalent of the posterior element of the foot.

Distr. 19. sp. Atlantic, Medit. Indian Ocean.

Fossil, 5 sp. Miocene —. Sicily, Turin, Dax.

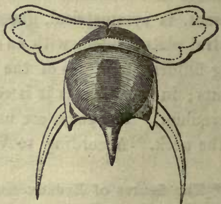

Fig. 107. H. tridentata.

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* *Theke* a case, *soma* a body; several of the genera have no shells.

CLEODORA, Peron and Lesueur.

Syn. Clio, L. (part) not Müller. Balantium, Leach MS.

Type, C. pyramidata, Pl. XIV. fig. 33.

Shell pyramidal, 3 sided, striated transversely; ventral side flat, dorsal keeled; aperture simple, triangular, with the angles produced; apex acute.

Animal with rudimentary eyes; tentacles obsolete; mantle-margin with a siphonal (?) process; fins ample, united ventrally by a rounded lobe; lingual teeth 1.1.1. The transverse bars of the gill, the heart, and other organs are visible through the pellucid shell. In C. curvata and pellucida (*Pleuropus,* Esch.) the mantle is furnished with two long filaments on each side.

Distr. 12 sp. Atlantic, Medit. Indian Ocean, Pacific, C. Horn.

Fossil. Miocene —. Brit. (C. *infundibulum,* Crag.)

Sub-genus. Creseis, Rang. (Styliola, Lesueur). C. aciculata, Pl. XIV. fig. 34. Slender, conical, pointed, straight or curved. Fins rather narrow, truncate, with small tentacles projecting from their dorsal edges, and rudiments of the *mesopodium* on their surface; mantle-margin with a spiral process on the left side. M. Rang states that he has seen these pteropods clustering round floating seaweed. *Distr.* 5 sp. (like *Cleodora.*)

CUVIERIA, Rang.*

Dedicated to Baron Cuvier. *Type,* C. columnella, Rang, Pl. XIV. fig. 35.

Shell cylindrical, transparent; aperture simple, transversely ovate; apex acute in the young, afterwards partitioned off, and usually deciduous.

Animal with simple narrow fins, united ventrally by two small lobes; lingual teeth 1.1.1.

Distr. 4 sp. Atlantic, India, Australia.

Fossil 1 sp. (C. Astesana, Rang.) *Pliocene,* Turin.

Sub-genus, Vaginella, Daud. V. depressa, Pl. XIV. fig. 36. *Shell* oblong, with a pointed apex; aperture contracted, transverse. *Fossil,* 1 sp. *Miocene.* Bordeaux, Turin.

THECA, Morris. 1845.

Type, T. lanceolata. *Syn.* Creseis, Forbes.† Pugiunculus, Barr.

Shell straight, conical, tapering to a point, back flattened, aperture trigonal. Lon. 1-8 inches.

Fossil, 6 sp. *Silurian.* N. America, Brit., New South Wales.

PTEROTHECA, Salter.

Type, P. transversa, Portlock, 3 sp. L. Silurian; Ireland, Wales, Canada.

Shell bi-lobed, transversely oval, with a dorsal keel projecting slightly at each end; ventral plate small triangular.

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* Under the name of "triptère," M.M. Quoy and Gaimard described the fragment of a pteropod, since ascertained to have been a *Cuvieria.*

† *Creseis Sedgwicki,* Forbes, is an orthoceras with very thin septa, belonging to the same group with (*Conularia*) *teres,* Sby. *Tentaculites,* Schl. is anellidous. (*Salter.*)

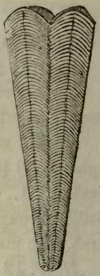

Fig. 108.*

? CONULARIA, Miller.

Etym. *Conulus*, a little cone. *Type*, C. quadrisulcata, fig. 108.

Shell four-sided, straight, and tapering, the angles grooved, sides striated transversely, apex partitioned off.

Fossil, 15 sp. Silurian — Carb. N. America, Europe, Australia.

Sub-genus, *Coleoprion* (gracilis) Sandberger; Devonian, Germany. *Shell* round, tapering, sides obliquely striated, striæ alternating along the dorsal line.

EURYBIA, Rang. 1827.†

Etym. *Eurybia*, a sea-nymph.

Ex. E. Gaudichaudi, Pl. XIV. fig. 37. (after Huxley.)

Animal globular; fins narrow, truncated and notched at the ends, united ventrally by a small lobe (metapodium); mouth with two elongated tentacles, behind which are minute eye-peduncles and a two-lobed rudimentary foot (*mesopodium*); body inclosed in a cartilaginous integument, with a cleft in front, into which the locomotive organs can be retracted. Lingual teeth 1.0.1.

The animal has no proper gill, but Mr. Huxley has observed two ciliated circles surrounding the body, as in the larva of *Pneumodermon*.

Distr. 3 sp. Atlantic, Pacific.

Sub-genus, *Psyche*, Rang. P. globulosa, Pl. XIV. fig. 38. *Animal* globular, with two simple oval fins. *Distr.* 1 sp. Off Newfoundland.

CYMBULIA, Peron and Lesueur.

Etym. Diminutive of *cymba*, a boat.

Type, C. proboscidea, Pl. XIV. fig. 39. (after Adams).

Shell cartilaginous, slipper-shaped, pointed in front, truncated posteriorly; aperture elongated, ventral.

Animal with large rounded fins connected ventrally by an elongated lobe; mouth furnished with minute tentacles; lingual teeth 1.1.1; stomach muscular, armed with two sharp plates.

Distr. 3 sp. Atlantic, Medit. India Ocean.

TIEDEMANNIA, Chiaje.

Type, T. Neapolitana, Pl. XIV. fig. 40. Named after Fr. Tiedemann.

Animal naked, transparent, fins united, forming a large rounded disk; mouth central; tentacles elongated, connate; eye-tubercles minute. Larva shell-bearing. *Distr.* 2 sp. Medit. Australia.

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* Carboniferous limestone, Brit. Belgium.

† This name had been previously employed for four different genera of plants and animals.

FAMILY II. LIMACINIDÆ.

Shell minute, spiral, sometimes operculate.

Animal with fins attached to the sides of the mouth, and united ventrally by an operculigerous lobe; mantle-cavity opening dorsally; excretory orifices on the right side.

The shells of the true *limacinidæ* are sinistral, by which they may be known from the fry of *Atlanta, Carinaria,* and most other Gasteropods.

LIMACINA, Cuvier.

Etym. Limacina, snail-like. *Syn.* Spiratella, Bl.

Ex. L. antarctica (drawn by Dr. Joseph Hooker), Pl. XIV. fig. 41.

Shell sub-globose, sinistrally spiral, umbilicated; whirls transversely striated; umbilicus margined; no operculum.

Animal with expanded fins, notched on their ventral margins; operc. lobe divided; lingual teeth 1.1.1.

Distr. 2 sp. Arctic and Antarctic Seas; gregarious.

SPIRIALIS, Eydoux and Souleyet.

Ex. S. bulimoides, Pl. XIV. fig. 42. *Syn.* Heterofusus, Flem. Heliconoides, D'Orb. Peracle, Forbes. Scaea, Ph.

Shell minute, hyaline, sinistrally spiral, globose or turrited, smooth or reticulated; operculum thin, glassy, semilunar, slightly spiral, with a central muscular scar.

Animal with narrow, simple fins, united by a simple, transverse operculigerous lobe; mouth central, with prominent lips.

Distr. 12 sp. Greenland and Norway to C. Horn, Indian Ocean, Pacific.

? CHELETROPIS, Forbes.

Etym. Chele, a claw, *tropis,* a keel. *Syn.* Sinusigera, D'Orb.

Type, C. Huxleyi, Pl. XIV. fig. 43.

Shell dextrally spiral, imperforate, double-keeled; nucleus sinistral; aperture channelled in front; peristome thickened, reflected, with two claw-like lobes.

Animal pteropodous ? gregarious in the open sea.

Distr. 2 sp. S. America, S. E. Australia.

Another minute spiral shell, recently discovered, may be noticed here:

MACGILLIVRAYIA. Forbes.

Named after its discoverer, the Naturalist to H. M. S. Rattlesnake.

Type, M. pelagica, Pl. XIV. fig. 44.

Shell minute, dextrally spiral, globular, imperforate, thin, horny, translucent; spire obtuse; aperture oblong, entire; peristome thin, incomplete, operc. thin horny, concentric, nucleus sub-external.

Animal with 4 long tentacles, mantle with a siphonal process; foot expanded, truncated in front, furnished with a float after the manner of *Ianthina;* lingual dentition closely resembling *Jeffreysia.*

Distr. 2 sp. Taken in the towing-net off C. Byron, E. coast Australia, 15 miles from shore; floating, and apparently gregarious. (J. Macgillivray.) Mindoro. (Adams.)

SECTION B. GYMNOSOMATA, Bl.

Animal naked, without mantle or shell; head distinct; fins attached to the sides of the neck; gill indistinct.

FAMILY III. CLIIDÆ.

Body fusiform; head with tentacles often supporting suckers; foot small, but distinct, consisting of a central and posterior lobe; heart *opistho-branchiate;* excretory orifices distant, on the right side; lingual teeth (in *Clio*) 12.1.12, central wide, denticulated, uncini strongly hooked and recurved.

CLIO (L.)* Müller.

Etym. Clio, a sea-nymph. *Syn.* Clione, Pallas.

Type, C. borealis, Pl. XIV. fig. 45. (C. caudata, L. part.)

Head with 2 eye tubercles and 2 simple tentacula; mouth with lateral lobes, each supporting 3 conical retractile processes, furnished with numerous microscopic suckers; fins ovate; foot lobed. In swimming, the Clio brings he ends of its fins almost in contact, first above and then below. (*Scoresby.*)

Distr. 4 sp. Arctic and Antarctic Seas, Norway, India.

Sub-genus ? *Cliodita* (fusiformis), Quoy and Gaimard. Head supported on a narrow neck; tentacles indistinct. 3 sp. Cape, Amboina.

PNEUMODERMON, Cuvier.

Etym. Pneumon, lung (or gill), *derma,* skin.

Type, P. violaceum, Pl. XIV. fig. 46.

Body fusiform; head furnished with ocular tentacles; lingual teeth 4.0.4; mouth covered by a large hood supporting two small, simple, and two large acetabuliferous tentacles, suckers numerous, pedicillate, neck rather contracted; fins rounded; foot oval, with a pointed posterior lobe; excretory orifice situated near the posterior extremity of the body, which has small branchial processes and a minute, rudimentary shell.

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* This name was employed by Linnæus for all the Pteropoda then known; his definition is most suited to the "northern clio," probably the only species with which he was personally acquainted. The first species enumerated in the Syst. Nat. is *C. caudata,* and reference is made to an indeterminable figure in Brown's Jamaica, and to Marten's account of the Spitzbergen mollusk (*C. borealis.*) In cases like this the rule is to adopt the practice of the next succeeding naturalist who defines the limits of the group more exactly.

In the fry of *Pneumodermon* the end of the body is encircled with ciliated bands. (Müller.)

Distr. 4 sp. Atlantic, India, Pacific Ocean.

Sub-genus ? *Spongiobranchæa*, D'Orbigny. S. Australis, Pl. XIV. fig. 47. Gill (?) forming a spongy ring at the end of the body; tentacles each with 6 rather large suckers. *Distr.* 2 sp. S. Atlantic (Fry of *Pneumodermon* ?). *Trichocyclus*, Eschscholtz, T. Dumerilii, Pl. XIV. fig. 48. *Animal* without acetabuliferous tentacles ? mouth proboscidiform; front of the head surrounded with a circle of cilia, and two others round the body.

? PELAGIA, Quoy and Gaimard.

Etym. Pelagus, the deep sea: (not = *Pelagia*, Peron and Les.)

Type, P. alba, Pl. XIV. fig. 49. Amboina.

Animal fusiform, truncated in front, rough; neck slightly contracted; fins small, fan-shaped.

CYMODOCÈA, D'Orbigny.

Etym. Kumodoke, a Nereid. *Type*, C. diaphana, Pl. XIV. fig. 50.

Animal fusiform, truncated in front, pointed behind; neck slightly contracted; fins 2 on each side, first pair large and rounded, lower pair ligulate; foot elongated; mouth proboscidiform. *Distr.* 1 sp. Atlantic.

CLASS IV. BRACHIOPODA, Cuvier, 1805,

(= Order *Pallio-branchiata*, Blainville, Prodr. 1814.)

The *Brachiopoda* are bivalve shell-fish which differ from the ordinary mussels, cockles, &c. in being always *equal-sided*, and never quite *equivalve*. Their forms are symmetrical, and so commonly resemble antique lamps, that they were called *lampades*, or "lamp-shells," by the old naturalists (Meuschen, 1787, Humphreys, 1797); the hole which in a lamp admits the wick, serves in the lampshell for the passage of the pedicle by which it is attached to submarine objects.*

The valves of the *Brachiopoda* are respectively dorsal and ventral; the ventral valve is usually largest, and has a prominent beak, by which it is attached, or through which the organ of adhesion passes. The dorsal, or smaller valve, is always free and imperforate. The valves are articulated by two curved teeth, developed from the margin of the ventral valve, and received by sockets in the other; this hinge is so complete that the valves cannot be separated without injury.† A few, abnormal genera, have no hinge; in *Crania* and *Discina* the lower valve is flat, the upper like a limpet; the valves of *Lingula* are nearly equal, and have been compared to a duck's bill. (Petiver).

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* The principal modifications of external form presented by these shells, are given in plate 15; the internal structure of each genus is illustrated in the woodcuts, which are the same with those in Mr. Davidson's Introduction, and in the British Museum Catalogue. They are from original studies by the author, unless otherwise stated.

† The largest recent *Terebratula* cannot be opened more than ½ of an inch, except by applying force.

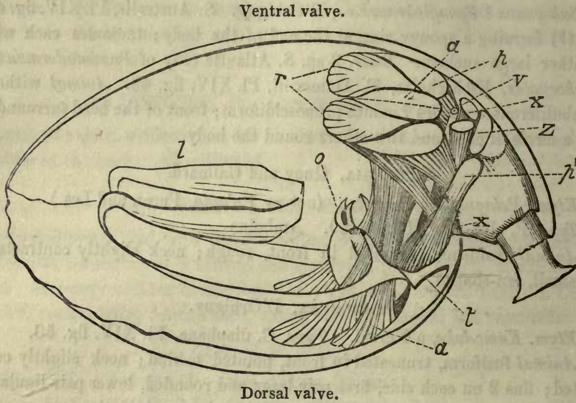

Fig. 109. *Muscular system of Terebratula.*[*]

a. a. adductor-muscles; ***r.*** cardinal-muscles; **x.** accessory cardinals; ***p.*** ventral pedicle-muscles; ***p.'*** dorsal pedicle-muscles; **z.** capsular-muscles; ***o.*** mouth; **v.** vent; ***l.*** loop; ***t.*** dental socket.

The valves are both opened and closed by muscles; those which open the shell (*cardinales*) originate on each side the centre of the ventral valve, and converge towards the hinge-margin of the free valve, behind the dental sockets, where there is usually a prominent *cardinal process.*[†] The teeth form the *fulcrum* on which the dorsal valve turns. The *adductor* muscles are four in number, and quite distinct in *Crania* and *Discina;* in *Lingula* the posterior pair are combined, and in *Terebratula* the four muscles are separate at their dorsal terminations, but united at their insertion in the centre of the larger valve. The pedicle is fixed by a pair of muscles (each doubly-attached) to the dorsal hinge-plate, and by another pair to the ventral valve, outside the cardinal muscles.[‡] In the hinge-less genera the contraction of the cardinal muscles must tend to slide the free valve forwards, and in *Crania* and *Discina* these muscles are attached to a prominent ventral process, which renders them less oblique; the upper valve is restored to its place by two pairs of *retractor* sliding-muscles, which are perhaps the equivalents of the dorsal pedicle muscles of *Terebratula.*[*] The muscles are remarkably glistening and tendinous, except at their expanded ends, which are soft and fleshy; their impressions are often deep, and always characteristic; but difficult of interpretation from their complexity, their change of position, and the occasional suppression of some and combination of others.[†]

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[*] *Waldheimia Australis, Quoy.* $\frac{2}{1}$. From a drawing by Albany Hancock, Esq.

[†] The term "retractors" used at p. 8 is relinquished for the more appropriate term "cardinal muscles," given by Prof. King. They are particularly interesting from their function, as antagonists of the adductor muscles, like the ligament of ordinary bivalves.

[‡] The muscular system of *Terebratula* presents a considerable amount of resemblance to that of *Modiola* (fig. 177); the anterior and posterior pedal muscles may be compared to the dorsal and ventral pedicle muscles.

On separating the valves of a recent *Terebratula*, the digestive organs and muscles are seen to occupy only a very small space near the beak of the shell, partitioned off from the general cavity by a strong membrane, in the centre of which is placed the animal's mouth. The large cavity is occupied by the fringed arms, which have been already alluded to (page 8) as the characteristic organs of the class. Their nature will be better understood by comparing them with the lips and labial tentacles of the ordinary bivalves (pp. 24, 27, fig. 171, *p.p.*); they are in fact lateral prolongations of the lips supported on muscular stalks, and are so long as to require being folded or coiled up. In *Rhynchonella* and *Lingula* the arms are spiral and separate; in *Terebratula* and *Discina* they are only spiral at the tips, and are united together by a membrane, so as to form a lobed disk. It has been conjectured that the living animals have the power of protruding their arms in search of food; but this supposition is rendered less probable by the fact that in many genera they are supported by a brittle skeleton of shell. The internal skeleton consists of two spiral processes in the *Spiriferidæ* (fig. 132), whilst in *Terebratula* and *Thecidium* it takes the form of a *loop*, which supports the brachial membrane, but does not strictly follow the course of the arms. The mode in which the arms are folded is highly characteristic of the genera of *Brachiopoda;* the extent to which they are supported by a calcarious skeleton is of less importance, and liable to be modified by age. That margin of the oral arms which answers to the lower lip of an ordinary bivalve, is fringed with long filaments (*cirri*[‡]), as may be seen even in dry specimens of recent *Terebratulæ*. In some fossil examples the *cirri* themselves were supported by slender processes of shell;[§] they cannot therefore be vibratile organs, but are probably themselves covered with microscopic *cilia*, like the oral tentacles of the ascidian polypes (*cilio-brachiata* of Farre). The anterior lip and inner margin of the oral arms is plain, and forms a narrow gutter along which the particles collected by the ciliary currents may be conveyed to the mouth. The object of the folding of the arms is obviously to give increased surface for the disposition of the *cirri*.

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[*] In *Discina* one pair of the retractor muscles seems to be actually inserted in the pedicle. Mr. Hancock compares the pedicle muscles with the *retractors* of the Bryozoa; he objects to the hypothesis of the sliding movement of the valves.

[†] Prof. King has shown that the compound nature of a muscular impression is often indicated by the mode in which the vascular markings proceed from it (as in figs. 140, 145.)

[‡] Called *cilia* at p. 8, but this term should be restricted to the microscopic organs which clothe the *cirri.*

[§] *Spirifera rostrata* and *Terebratula pectunculoides*, in the British Museum.

The mouth conducts by a narrow œsophagus to a simple stomach, which is surrounded by the large and granulated liver; the intestine of *Lingula* is reflected dorsally, slightly convoluted, and terminates between the mantle lobes on the *right* side (fig. 165). In *Orbicula* it is reflected ventrally, and passes straight to the right, ending as in *Lingula*. In *Terebratula*, *Rhynchonella*, and probably all the *normal* Brachiopoda, the intestine is simple and reflected ventrally, passing through a notch or foramen in the hinge-plate, and ending behind the ventral insertion of the adductor muscle (fig. 109, v.)*

The interior of the valves is lined by the two lobes of the mantle, which are often fringed with fine horny bristles (*setæ*); these are quite straight, brittle, and deeply implanted between the laminæ of the mantle; they serve to guard the opening of the valves. The mantle-lobes of the *Brachiopoda* are not only organs by which the shell is formed, they are also provided with large veins by which respiration is effected; in the *Terebratulidæ* there are two great venous trunks in the dorsal mantle-lobe, four in the ventral; in *Rhynchonella* and *Discina* the lobes are similar, and the *Orthidæ* have four large veins in the dorsal lobe and only two in the ventral. The first indication of a special breathing organ is presented by *Lingula*, in which the veins develope parallel rows of small vascular processes. (*Cuvier*.) The veins open into the visceral cavity,† which is itself a great vascular sinus. There are two organs which Prof. Owen regards as hearts, each consisting of an auricle and a ventricle, situated near the sides of the mouth in *Terebratula*; but in *Lingula* (fig. 165, *h*.) they are more posterior, and quite at the sides. The ventricles propel the blood into the visceral and pallial arteries, and are therefore both branchial and systemic. The pallial arteries are very slender, and accompany the veins on their outer surfaces, forming linear impressions along the centre of the vascular markings in some fossil shells (fig. 141).

The *ova* of *Terebratula* are developed within the large veins, which they accompany as far as the secondary branches. In the *Rhynchonellidæ*, and probably in the extinct *Orthidæ*, the ovaria do not extend into the venous trunks, but occupy large sinuses on each side of the body; and in *Discina* and *Lingula* they (or the testes) fill the interstices of all the viscera, but do not appear to extend into the mantle. The ova are supposed to escape by two orifices, situated at the sides of the mouth in *Terebratula*. (Hancock.)

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* The position at which the intestine terminates in the *Terebratulæ* and *Rhynchonellæ*, seems to necessitate the escape of the fæces by the umbonal opening; in those extinct genera which have the foramen closed at an early age, there is still an opening between the valves (e. g. in *Uncites*) which has been mistaken for a byssal notch.

† The veins do not terminate in hearts as formerly supposed; the statement at p. 30, line 27, should be erased.

Recent *Discinæ* often have minute fry attached to their valves, and Mr. Suess, of Vienna, has noticed a specimen of the fossil *Stringocephalus*, which contained numerous embryo shells.

Nothing is yet known respecting the development of the *Brachiopoda*, but there can be no doubt that in their first stage they are free and able to swim about, until they meet with a suitable position. It is probable that in the second stage they all adhere by a byssus, which in most instances becomes consolidated, and forms a permanent organ of attachment. Some of the extinct genera (e. g. *Spirifera* and *Strophomena*) appear to have become free when adult, or to have fixed themselves by some other means. Four genera, belonging to very distinct families, cement themselves to foreign objects by the substance of the ventral valve.

The Lamp-shells are all natives of the sea. They are found hanging from the branches of corals, the under sides of shelving rocks, and the cavities of other shells. Specimens obtained from rocky situations are frequently distorted, and those from stony and gravelly beds, where there is motion in the waters, have the beak worn, the foramen large, and the ornamental sculpturing of the valves less sharply finished. On clay beds, as in the deep clay strata, they are seldom found; but where the bottom consists of calcarious mud they appear to be very abundant, mooring themselves to every hard substance on the sea-bed, and clustering one upon the other.

Some of the *Brachiopoda* appear to attain their full growth in a single season, and all, probably, live many years after becoming adult. The growth of the valves takes place chiefly at the margin; adult shells are more globular than the young, and aged specimens still more so. The shell is also thickened by the deposit of internal layers, which sometimes entirely fill the beak, and every portion of the cavity of the interior which is not occupied by the animal, suggesting the notion that the creature must have died from the plethoric exercise of the calcifying function, converting its shell into a mausoleum, like many of the ascidian zoophytes.

The intimate structure of the shell of the *Brachiopoda* has been investigated by Mr. Morris, Prof. King, and more recently by Dr. Carpenter; according to the last observer, it consists of flattened prisms of considerable length, arranged parallel to each other with great regularity, and obliquely to the surfaces of the shell, the interior of which is imbricated by their out-crop (fig. 110.) This structructure only is found in the *Rhynchonellidæ*; but in most—perhaps all the other *Brachiopoda**— the shell is traversed by canals, from one surface

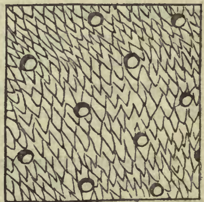

Fig. 110. *Terebratula.*

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* The fossil shells of the older rocks are so generally pseudomorphous, or partake of the metamorphic character of the rock itself, that it is difficult to obtain specimens in a state fit for microscopic examination.

to the other, nearly vertically, and regularly, the distance and size of the perforations varying with the species. Their external orifices are trumpet-shaped, the inner often very small; sometimes they bifurcate towards the exterior, and in *Crania* they become arborescent. The canals are occupied by cœcal processes of the outer mantle-layer,* and are covered externally by a thickening of the epidermis. Mr. Huxley has suggested that these cœca are analogous to the vascular processes by which in many ascidians the *tunic* adheres to the *test;* the extent of which adhesion varies in closely allied genera. The large tubular spines of the *Productidæ* must have been also lined by prolongations of the mantle; but their development was more probably related to the maintenance of the shell in a fixed position, than to the internal economy of the animal. (*King.*) Dr. Carpenter states that the shell of the *Brachiopoda* generally contains less animal matter than other bivalves; but that *Discina* and *Lingula* consist almost entirely of a horny animal substance, which is laminar, and penetrated by oblique tubuli of extreme minuteness. He has also shown that there is not in these shells that distinction between the outer and inner layers, either in structure or mode of growth, which prevails among the ordinary bivalves; the inner layers only differ in the minute size of the perforations, and the whole thickness corresponds with the outer layer only in the *Lamellibranchiata.* The loop, or brachial processes, are always impunctate.

Of all shell-fish the *Brachiopoda* enjoy the greatest range both of climate, and depth, and time; they are found in tropical and polar seas; in pools left by the ebbing tide, and at the greatest depths hitherto explored by the dredge. At present only 70 recent species are known; but many more will probably be found in the deep-sea, which these shells mostly inhabit. The number of living species is already greater than has been discovered in any *secondary* stratum, but the vast abundance of fossil *specimens* has made them seem more important than the living types, which are still rare in the cabinets of collectors, though far from being so in the sea. Above 1,000 extinct species of Brachiopoda have been described, of which more than half are found in England. They are distributed throughout all the sedimentary rocks of marine origin from the Cambrian strata upwards, and appear to have attained their maximum, both of generic and specific development, in the Devonian age.* The oldest form of organic life at present known, both in the old and new world, is a *Lingula.* Some species (like *Atrypa reticularis*) extend through a whole "system" of rocks, and abound equally in both hemispheres; others (like *Spirifera striata*) range from the Cordillera to the Ural mountains. One recent Terebratula (*caput-serpentis*) made its appearance in the Miocene Tertiary; whilst others, scarcely distinguishable from it, are found in the Upper Oolite, and throughout the Chalk series and London Clay.*

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* Called the "lining membrane of the shell," by Dr. Carpenter. (Davidson Intr. Mon. Brach.) Mr. Quekett states that the perforations are closed externally by disks, surrounded by radiating lines, supposed to indicate the existence of vibratile cilia in the living specimens.

† The number of Devonian species amounts to 300; but these were not all living *at one time,* they are obtained from a whole series of deposits, representing a succession of periods.

FAMILY I. TEREBRATULIDÆ.

Shell minutely punctate; usually round or oval, smooth or striated; ventral valve with a prominent beak, and two curved hinge-teeth; dorsal valve with a depressed umbo, a prominent cardinal process between the dental sockets, and a slender shelly loop.

Animal attached by a pedicle, or by the ventral valve: oral arms united to each other by a membrane, variously folded; sometimes spiral at their extremities.

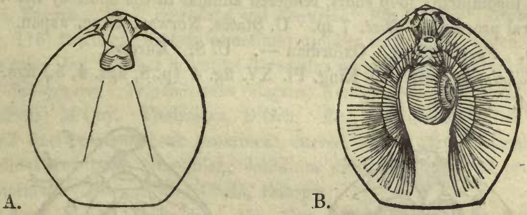

Fig. 111. *Terebratula vitrea, Born.*

TEREBRATULA, (Llhwyd.) Brug. Lamp-shell.

Etym. Diminutive of *terebratus,* perforated.

Syn. Lampas, Humph. Gryphus, Muhlfeldt. Epithyris, Phil.

Types, T. maxillata, Pl. XV. fig. 1, (= Ter. minor-subrubra, Llhwyd. Anomia terebratula, L.) T. vitrea, fig. 3.

Shell smooth, convex; beak truncated and perforated; foramen circular; deltidium of two pieces, frequently blended; loop very short, simple, attached by its crura to the hinge-plate. (Fig. 111, A.)

Animal attached by a pedicle; brachial disk tri-lobed, centre lobe elongated and spirally convoluted. (Fig. 111, B.) The young of *T. diphya* (Pygope of Link) has bi-lobed valves, (Pl. XV. fig. 2.); when adult the lobes unite, leaving a round hole through the centre of the shell.

Distr. 1 sp. Medit. 90—250 fathoms on nullipore mud. (*Forbes.*)

Fossil, 100 sp. Devonian —. World-wide.

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* The author has to ackowledge his obligation to Mr. Davidson for the use of the notes, drawings and specimens, assembled during the preparation of his great work on the British Fossil Brachiopoda, printed for the Palæontographical Society; to which work the student is referred for more copious descriptions and illustrations.

Sub-genera. Terebratulina (caput-serpentis) D'Orb. Pl. XV. fig. 3. Fig. 112. *Shell* finely striated, auriculate, deltidium usually rudimental;

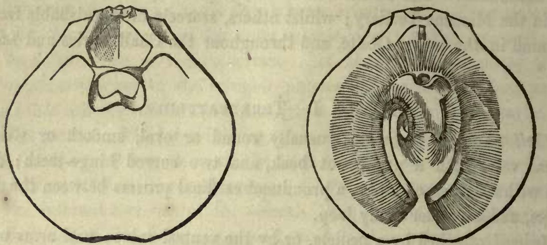

Fig. 112. *Dorsal valve:* *Animal.* $\frac{2}{1}$

foramen incomplete; loop short, rendered annular in the adult by the union of the oral processes. *Dist.* 7 sp. U. States, Norway, Cape, Japan. 10—120 fms. *Fossil,* 20 sp. Oxfordian —. U. S. Europe.

Waldheimia (australis) King. Pl. XV. fig. 4 (p. 8, figs. 4, 5.) figs. 109, 113, 114.

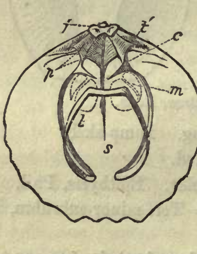

Fig. 113. *Dorsal valve.*

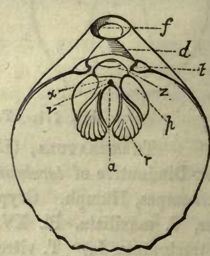

Fig. 114. *Ventral valve.*

Fig. 113. *j*, cardinal process; *t'*, dental sockets; *p*, hinge-plate; *s*, septum; *c*, crura of the loop; *l*, reflected portion of the loop; *m*, quadruple adductor-impression.

Fig. 114. *f*, foramen; *d*, deltidium; *t*, teeth; *a*; single adductor-impression; *r*, cardinal muscles; *x*, accessory muscles; *p*, pedicle muscles; *v*, position of the vent; *z*, attachment of pedicle-sheath.

Shell smooth or plaited, dorsal valve frequently impressed; foramen complete; loop elongated and reflected; septum (*s*) of smaller valve elongated. *Distr.* 9 sp. Norway, Java, Australia, California, Cape Horn. Low-water—100 fms. *Fossil,* 60 sp. Trias —. S. America, Europe. *Eudesia* (cardium) King, includes 1 recent, and 6 fossil species which are sharply plaited. *T. impressa* (Pl. XV. fig. 5) is the type of a group which has the external shape of *Terebratella.*

TEREBRATELLA, D'Orbigny.

Type, T. dorsata, Gmel. (= Magellanica, Chemn.) Pl. XV. fig. 7. Fig. 115.

Shell smooth or radiately plaited; dorsal valve longitudinally impressed; hinge-line straight, or not much curved; beak with a flattened area on each side of the deltidium; foramen large; deltidium incomplete; loop attached to the septum (*s*).

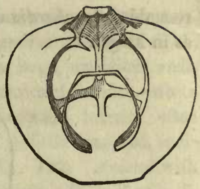

Fig. 115. *Terebratella.*

Animal like *Terebratula;* the spiral lobe of the brachial disk becomes very diminutive in some species, and is obsolete in *Morrisia* and *T. Cumingii. Distr.* excluding subgenera, 16 sp. Cape Horn, Valparaiso (90 fms.), New Zealand, Japan, Ochotsk, Spitzbergen, Labrador. *Fossil,* 16 sp. Lias —. U.S. Europe. In *T. crenulata* and *Evansii* (fig. 116) the dorsal septum sometimes projects so far as to touch the opposite valve, but in other examples it remains undeveloped. (*Davidson.*)

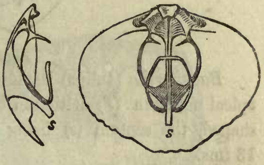

Fig. 116. *Ter; Evansii.* Dav.

Sub-genera. Trigonosemus (elegans) König. *Syn.* Delthyridæa (pectiniformis) M'Coy. Fissirostra, D'Orb. *Ex.* T. Palissii, Pl. XV. fig. 8. *Shell* finely plaited, beak prominent, curved, with a narrow apical foramen; cardinal area large, triangular; deltidium solid, flat; cardinal process very prominent. *Distr.* 5 sp. Chalk, Europe.

Lyra (Meadi) Cumberland, Min. Con. 1816. Pl. XV. fig. 6. *Syn.* Terebrirostra, D'Orb. Rhynchora, Dalman.* *Shell* ornamented with rounded ribs; beak very long, divided lengthwise internally, by the dental plates; loop doubly attached ? *Distr.* 4 sp. cretaceous: Europe. Three species of similar form are found in the Trias of St. Cassian.

Magas (pumila) Sby. Fig. 117. Shell smooth, conspicuously punctate, dorsal valve impressed, foramen angular, deltidium rudimentary; internal septum (*s*) prominent, touching the ventral valve; reflected portions of the loop disunited (*l*). 2 sp. U. Green-sand — Chalk. Europe. The recent *Ter. Cumingii,* of New Zealand,

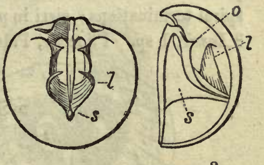

Fig. 117. *M. pumila.* $\frac{2}{1}$

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* The name *Rhynchora* was given by Dalman to the Ter. costata. Wahl. (= T. pectinata, L.) on the supposition that it was identical with Sowerby's *T. Lyra*; and as no specimen could be found with a long beak, an artificial one was manufactured for it, of which there is a cast in the Brit. M. The second species of "Rhynchora," *Ter. spatulata,* Wahl. has no beak whatever: in shape it is like an *Argiope*, but measures an inch each way. The ventral valve is a simple bent plate with the teeth at the angles; the dorsal valve is flat, with a very wide hinge-plate, and sockets at the angles, whilst a single septum projects from the centre, with portions of a loop attached.

resembles *Bouchardia* externally, but has the diverging processes of the loop as in Magas.

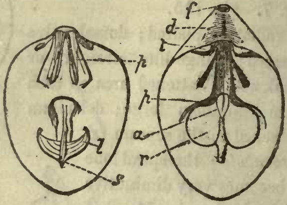

Fig. 118. *B. tulipa, Bl.**

Bouchardia (tulipa) Davidson, fig. 118. Beak prominent, with a minute apical foramen (*f*) deltidium blended with the shell (*d*) apophysis anchor-shaped, the septum (*s*) being furnished with two short lamellæ. Brazil, 13 fms.

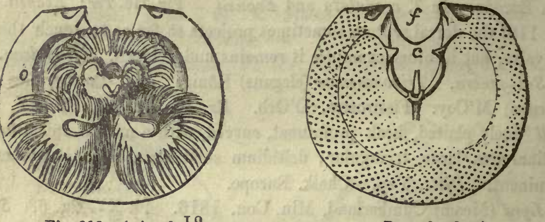

Fig. 119. *Animal.* $\frac{10}{1}$ *Dorsal valve.*†

Morrisia (anomioides, Scacchi) Davidson. Fig. 119. *Shell* minute, conspicuously punctate; foramen large, encroaching equally on both valves; hinge area small, straight; loop not reflected, attached to a small forked process in the centre of the valve. *Animal* with sigmoid arms, destitute of spiral terminations; cirri in pairs. *Distr.* 2 sp. Medit. 95 fms. (*Forbes.*) ? *Fossil.* 1 sp. Pliocene, Palermo.

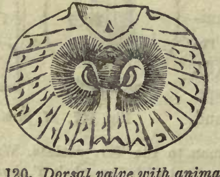

Fig. 120. *Dorsal valve with animal.* $\frac{2}{1}$

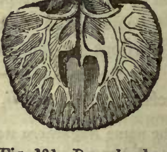

Fig. 121. *Dorsal valve.*

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* The muscular impressions in *Bouchardia* have been compared with those of *Ter. Cumingii*, of which the animal is known. The large impressions (*r*) in the disk of the ventral valve appear to be formed by the cardinal muscles; *a.* by the adductor; *p.* by the pedicle muscles.

† Fig. 119. *c.* loop; *f.* pedicle notch; *o.* the ovaries. From the originals in Mr. Davidson's collection; magnified ten diameters.

Kraussia (rubra) Dav. Cape. Fig. 121. K. Lamarckiana, Dav. Australia. Fig. 120. *Shell* transversely oblong; hinge-line nearly straight; beak truncated, laterally keeled; area flat; foramen large, deltidium rudimentary; dorsal valve longitudinally impressed, furnished inside with a forked process rising nearly centrally from the septum; interior often strongly tuberculated. The apophysis is sometimes a little branched, indicating a tendency towards the form it attains in fig. 122. *Animal* with rather small oral arms, the spiral lobe very diminutive. *Distr.* 6 sp. S. Africa, Sydney, N. Zealand; low-water to 120 fms.

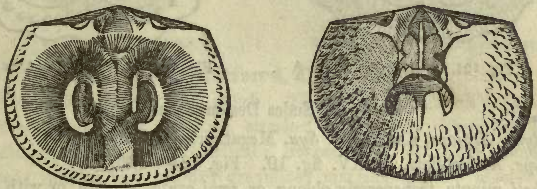

Fig. 122. *Animal.* *Dorsal valve.*

? *Megerlia* (truncata) King, 1850. Pl. XV. fig. 9. Fig. 122. *Loop* trebly attached; to the hinge-plate by its crura, and to the septum by processes from the diverging and reflected portions of the loop. *Distr.* 2 sp. Medit. Philippines. These species belong to the same natural group with *Kraussia.*

? *Kingena* (lima) Dav. Cretaceous, Europe, Guadaloupe. Valves spinulose; loop trebly attached.

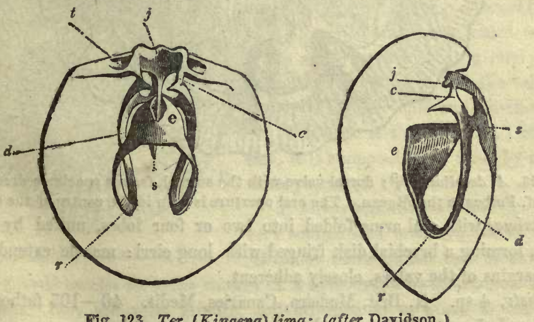

Fig. 123. *Ter.* (*Kingena*) *lima*; (*after* Davidson.)

t. dental sockets; *j.* cardinal process, *c.* crura; *d.* diverging processes of loop; *r*, reflected portion; *e.* third attachment of loop; *s.* dorsal septum.

? *Ismenia* (pectunculus) King. Coral rag, Europe. Valves ornamented with corresponding ribs; loop trebly attached.

? *Waltonia* (Valenciennei) Dav. New Zealand. Perhaps the fry of *Ter. rubicunda,* with the reflected part of the loop wanting.

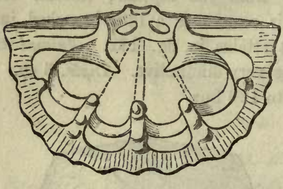

Fig. 124. *Argiope decollata.* $\frac{4}{1}$

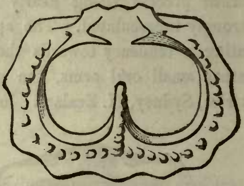

Fig. 125. *A. Neapolitana,* Sc.* $\frac{8}{1}$

ARGIOPE, Eudes Deslongchamps.

Etym. Argiope, a nymph. *Syn.* Megathyris, D'Orb.

Type, A. decollata, Pl. XV. fig. 10. Fig. 124—126.

Shell minute, transversely oblong or semi-ovate, smooth or with corresponding ribs; hinge line wide and straight, with a narrow area to each valve; foramen large, deltidium rudimentary; interior of dorsal valve with one or more prominent, sub-marginal septa; loop two or four-lobed, adhering to the septa, and more or less confluent with the valve.

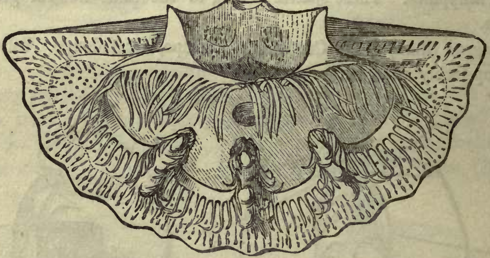

Fig. 126. *A. decollata,* $\frac{40}{1}$; dorsal valve with the animal, from a specimen dredged by Prof. Forbes in the Ægean. The oral aperture is seen in the centre of the disk.

Animal with oral arms folded into two or four lobes, united by membrane, forming a brachial disk fringed with long cirri: mantle extending to the margins of the valves, closely adherent.

Distr, 4 sp. N. Brit. Madeira, Canaries, Medit. 40—105 fathoms.

Fossil. 5 sp. U. Greensand —. Europe.

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* Interiors of dorsal valves magnified, from the originals in Coll. Davidson.

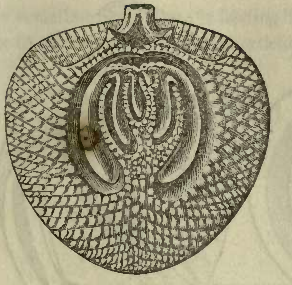

Fig. 127. *T. radians.*

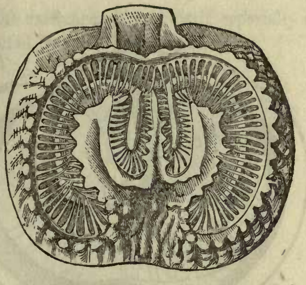

Fig. 128. *T. Mediterraneum.** $\frac{4}{1}$

Thecidium, Defrance.

Etym. Thekidion, a small pouch. *Type,* T. radians, Pl. XV. fig. 11.

Shell small, thick, punctate, attached by the beak; hinge-area (*h*) flat; deltidium (*d*) triangular, indistinct: *dorsal valve* (fig. 127) rounded, depressed; interior with a broad granulated margin; cardinal process prominent, between the dental sockets; oral processes united, forming a bridge over the small and deep visceral cavity; disk grooved for the reception of the loop, the grooves separated by branches from a central septum; loop often unsymmetrical, lobed, and united more or less intimately with the sides of the grooves: *ventral valve* (fig. 129) deeply excavated, hinge-teeth prominent; cavities for the adductor (*a*) and pedicle muscles (*p*) small; disk occupied by two large smooth impressions of the cardinal muscles, bordered by a vascular line. *Animal* (fig. 128) with elongated oral arms, folded on themselves and fringed with long cirri; mantle extending to the margin of the valves and closely adherent; epidermis distinct.

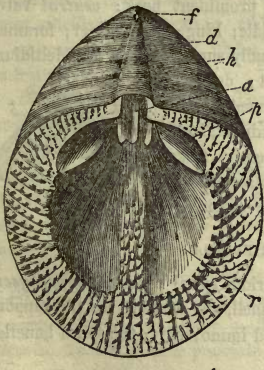

Fig. 129. *T. radians,* $\frac{4}{1}$.

T. radians is the only un-attached species, it is supposed to be fixed by a pedicle when young (D'Orb.)

T. hieroglyphicum, Pl. XV. fig. 12, has a very complicated interior; whilst in several others there are but two brachial lobes. The Liassic species form the subject of a monograph by M. Eugene Deslongchamps; they are often minute, and attached in numbers to sea-urchins, corals, and terebratulæ.

Distr. 1 sp. Medit. *Fossil,* 27 sp. Trias —. Europe.

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* Dorsal valve with the animal, magnified. Coll. Davidson.

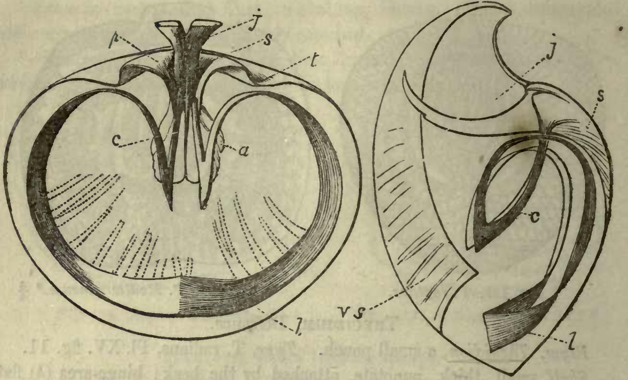

Fig. 130. *Dorsal valve.* *Profile.**

a, adductor; *c*, crura; *l*, loop; *j*, cardinal process; *p*, hinge-plate; *s*, dorsal septum; *v. s.* ventral septum; *t*, dental sockets.

? STRINGOCEPHALUS, Defrance.

Etym. *Strinx* (*stringos*) an owl, *cephale* the head.†

S. Burtini, Pl. XV. fig. 13. Fig. 130, 131. Devonian, Europe.

Shell punctate; sub-orbicular, with a prominent beak: *ventral* valve with a longitudinal septum (*v. s.*) in the middle; hinge-area distinct; foramen large and angular in the young shell, gradually surrounded by the deltidium and rendered small and oval in the adult; deltidium composed of three elements; teeth prominent; *dorsal* valve depressed, cardinal process (*j*) very prominent, sometimes touching the opposite valve, its extremity forked to receive the ventral septum (*v.s.*); hinge-plate (*p*) supporting a shelly loop, after the manner of *Argiope*.

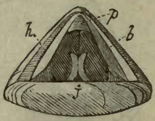

Fig. 131.‡

FAMILY II. SPIRIFERIDÆ.

Shell furnished internally with two calcarious spiral processes (*apophyses*) directed outwards, towards the sides of the shell, and destined for the support of the oral arms; which must have been fixed immoveably; the spiral lamellæ are sometimes spinulose, indicating the existence of rigid cirri, especially on the front of the whirls; valves articulated by teeth and sockets.

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* The loop (which was discovered by Prof. King) has a distinct suture in the middle; the dotted lines proceeding from its inner edge are added from a drawing by Mr. Suess, and represent what he regards as shelly processes for supporting a membranous disk. They may be portions of spirals, whose outer whirls are confluent.

† Internal casts of *Producta gigantea* are called "owl-heads" by quarrymen in the North of England. (*Sowerby*).

‡ Fig. 131. Young shell, magnified 4 diameters; *h*, hinge area; *b*, deltidium: *p*, pseudo-deltidium.

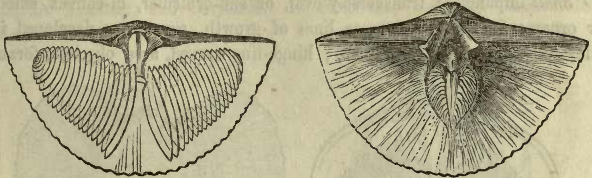

Fig. 132. *Dorsal*; *Ventral valve.*½

SPIRIFERA, Sowerby.

Type, S. striata, Sby. fig. 132. *Syn*. Trigonotreta, König. Choristites. Fischer. Delthyris, Dalman. Martinia &c. M'Coy.

Shell impunctate,* transversely oval or elongated, tri-lobed, beaked, biconvex, with a dorsal ridge and ventral furrow; hinge-line wide and straight; area moderate, striated across; foramen angular, open in the young, afterwards progressively closed; *ventral* valve with prominent hinge-teeth, and a central muscular scar, consisting of the single adductor flanked by two cardinal impressions: *dorsal* valve with a small cardinal process, a divided hinge-plate, and two conical spires directed outwards and nearly filling the cavity of the shell; crura united by an oral loop. The shell and spires are sometimes silicified, in limestone, and may be developed by means of acid. In *S. mosquensis* the dental plates are prolonged nearly to the front of the ventral valve.

Distr. 200 sp. L. Sil. — Trias. Arctic America — Chile, Falkland Ids. Europe; China; Thibet; Australia; Tasmania. In China these and other fossils are used as medicine.

Sub-genera. Spiriferina, D'Orb. S. Walcotti, Pl. 15, f. 14. *Shell* punctate, external surface spinulose; foramen covered by a pseudo-deltidium; interior of ventral valve with a prominent septum, rising from the adductor scar. *Distr.* 6 sp. Trias — L. Oolites. Brit. France, Germany, S. America.

Cyrtia, Dalman. C. exporrecta, Pl. XV. fig. 15. *Shell* impunctate, pyramidal, beak prominent, area equiangular, deltidium with a small tubular foramen. *Fossil,* 7 sp. Silur. — Trias. Europe. In *C. Buchii, heteroclyta, calceola,* &c. the shell is punctate.

ATHYRIS, M'Coy.

Etym. A, without, *thuris*, a door.† (i. e. deltidium).

Syn. Spirigera, D'Orb. Cleiothyris, King (not Phil.)

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* Prof. King attributes this to metamorphism; *S. Demarlii.* Bouch. from the Devonian limestone, is punctate. (*Carpenter*).

† Sometimes employed, *incorrectly*, in the sense of a door-*way* or foramen.

Types, A. concentrica, Buch. A. Roissyi, fig. 133, 134. A. lamellosa, Pl. XV. fig. 16.

Shell impunctate, transversely oval, or sub-orbicular, bi-convex, smooth, or ornamented with squamose lines of growth, sometimes developed into wing-like expansions, (fig. 134*); hinge-line curved, area obsolete, foramen round, truncating the beak, deltidium obsolete; hinge-plate of dorsal valve with four muscular cavities, perforated by a small round foramen, and supporting a small complicated loop (?) between the spires; spires directed outwards, crura united by a prominent oral loop.

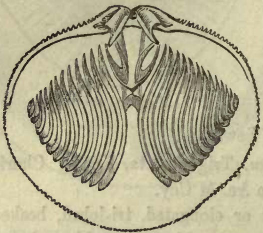

Fig. 133. *Interior of dorsal valve.*

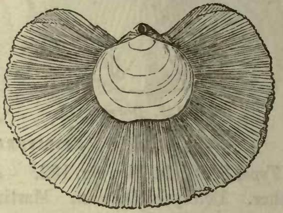

Fig. 134. *Specimen with fringe.*

The foramen in the hinge-plate occupies the situation of the notch through which the intestine passes in the recent *Rhynchonellæ;* in *A. concentrica* a slender curved tube is sometimes attached to the foramen, beneath the hinge-plate. *A. tumida* has the hinge-plate merely grooved, and the byssal foramen is angular.

Fossil, about 20 sp. Silurian — Lias. N. and S. America; Europe.

Sub-genus? Merista, Suess. Ter. scalprum, Rœmer, (A. cassidea, Quenst. Sp. plebeia. Ph.) Silurian — Devonian; Europe. *Shell* impunctate, dental plates (*v*) and dorsal septum (*d*) supported by arched plates (" shoe-lifter" processes, of King) which readily detach, leaving cavities (as in fig. 135); spiral arms have been observed in all the species.

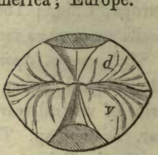

Fig. 135. *Merista.*

Retzia, King.

Dedicated to the distinguished Swedish naturalist, Retzius.

Type, Ter. Adrieni, Vern. *Ex.* R. serpentina, Carb. L. Belgium. Fig. 136.

Shell punctate, terebratula-shaped; beak truncated by a round foramen rendered complete by a distinct deltidium: hinge-area small, triangular, sharply defined; interior with diverging shelly spires.

Fossil, about 20 species. Silurian — Trias. S. America. U. S. Europe.

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* The spurious genus *Actinoconchus* (M'Coy) was founded on this character; similar expansions are formed by species of Atrypa, Camarophoria, and Producta.

Prof. King first pointed out the existence of calcarious spires in several *Terebratulæ* of the older rocks, and others have been discovered by MM. Quenstedt, De Koninck, and Barrande. In form they resemble Terebratulina, Eudesia, and Lyra.

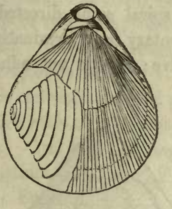
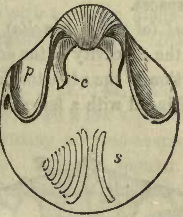


Fig 136. *Retzia serpentina, D. K.*



Fig, 137, *Uncites gryphus.*

UNCITES, Defrance.

Type, U. gryphus, Pl. XV. fig. 17. Fig 137. *Fossil,* Devonian. Europe.

Shell impunctate; oval, bi-convex, with a long incurved beak; foramen apical, closed at an early age; deltidium, large, concave; spiral processes directed outwards; no hinge-area.

The large, concave deltidium of Uncites so much resembles the channel formed by the dental plates of *Pentamerus,* that Dalman mistook the shell for a member of that genus. The discovery of internal spires, by Prof. Beyrich, shows that it only differs from *Retzia* in being impunctate and destitute of hinge-area. Some of the specimens have corresponding depressions in the sides of the valves (fig. 137, *p*) forming pouches which do not communicate with the interior.

FAMILY III. RHYNCHONELLIDÆ.

Shell impunctate, oblong, or trigonal, beaked; hinge-line curved; no area; valves articulated, convex, often sharply plaited; foramen beneath the beak, usually completed by a deltidium, sometimes concealed; hinge-teeth supported

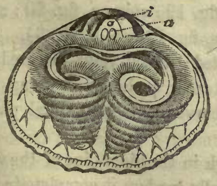


Fig. 138. *R. nigricans.*

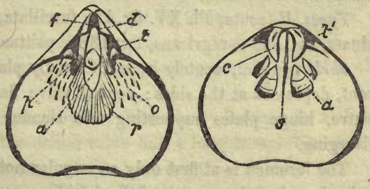


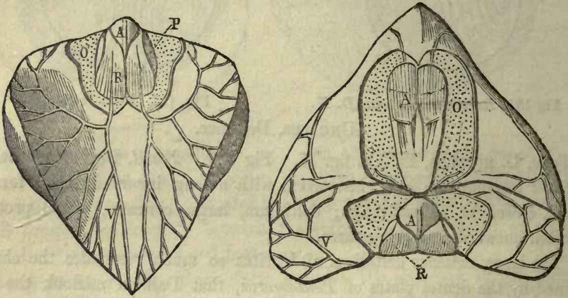
Fig. 139. *Ventral:* *Dorsal.*

Fig. 138. Dorsal valve with the animal; *a,* adductor muscles: *i,* intestine.

Fig. 139. R. psittacea, interiors. *s,* septum; *f,* foramen; *d,* deltidium; *t,* teeth; *t',* sockets; *c,* oral lamellæ; *a,* adductor impressions; *r,* cardinal; *p,* pedicle muscles; *o,* ovarian spaces.

by dental plates; hinge-plate deeply divided, supporting oral lamellæ, rarely provided with spiral processes; muscular impressions grouped as in *Terebratula;* vascular impressions consisting of two principal trunks in each valve, narrow, dichotomising, angular, the principal posterior branches inclosing ovarian spaces.

Animal (of *Rhynchonella*) with elongated spiral arms, directed inwards, towards the concavity of the dorsal valve; alimentary canal terminating behind the insertion of the adductor in the ventral valve; mantle not adhering, its margin fringed with a few short setæ.



Ventral aspect. *Umbonal aspect.*

Fig. 140. *Rh. acuminata, internal casts.*

Fig. 140. Umbonal aspect, with the dorsal valve above (Coll. Prof. King). Ventral aspect (Coll. Prof. Morris). A, adductor; R, cardinal; P, pedicle; V, vascular; O, ovarian impressions.

RHYNCHONELLA. Fischer.

Syn. Hypothyris, Phil. Hemithyris (psittacea) D'Orb. Acanthothyris (spinosa) D'Orb. Cyclothyris (latissima) M'Coy. Trigonella (part) Fischer (not L. nor Da Costa).

Types, R. acuta, Pl. XV. fig. 18: furcillata, fig. 19: spinosa, fig. 20: acuminata, fig. 140: nigricans, fig. 138; psittacea, fig. 139 (p. 8, fig. 3).

Shell trigonal, acutely beaked, usually plaited; dorsal valve elevated in front, depressed at the sides; ventral valve flattened, or hollowed along the centre, hinge plates supporting two slender curved lamellæ; dental plates diverging.

The foramen is at first only an angular notch in the hinge-line of the ventral valve, but the growth of the deltidium usually renders it complete in the adult shell; in the cretaceous species it is tubular. In *R. acuminata* and many other palæozoic examples, the beak is so closely incurved as to allow no space for a pedicle. Both the recent *Rhynchonellæ* are black; *R. octoplicata* of the Chalk sometimes retains six dark spots.

Distr. 2 sp. *R. psittacea,* Labrador (low water?) Hudson's Bay, 100 fms.: Melville Id. Sitka; Icy Sea. *R. nigricans,* New Zealand, 19 fms.

Fossil, 250 sp. L. Silurian —. N. and S. America, Europe, Thibet, China.

Sub-genera. ? *Porambonites,* Pander. P. æquirostris, Schl. *Shell* impunctate; surface minutely pitted; each valve with a minute hinge-area and indications of two septa; foramen angular, usually concealed. *Distr.* 4 sp. L. Silurian. Russia, Portugal.

Camarophoria, King. T. Schlotheimi, Buch. Figs. 141, 142. Ventral valve with converging dental plates (*d*) supported on a low septal ridge (*s*); dorsal valve with a prominent septum (*s*) supporting a spoon-shaped central process (*v*); oral lamellæ long and slender (*o*). Foramen angular, cardinal process distinct (*j*). *Fossil,* 9 sp. ? Carb. — Permian (Magnesian limestone). Germany; England.

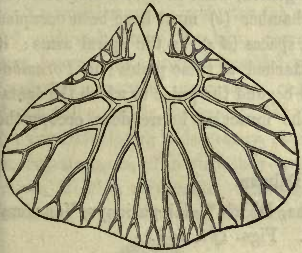


Fig. 141. Internal cast.*

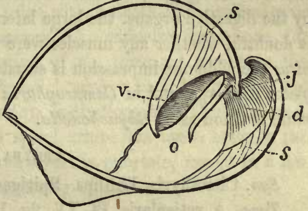


Fig. 142. Section.

PENTAMERUS, Sowerby.

Etym. *Pentameres,* 5-partite.

Syn. Gypidia (conchydium) Dalman.

Type, P. Knightii, Pl. XV. fig. 22. Fig. 143.

Shell impunctate, ovate, ventricose, with a large incurved beak; valves usually plaited; foramen angular; no area or deltidium; dental plates (*d*) converging, trough-like, supported on a prominent septum (*s*); dorsal valve with two contiguous longitudinal septa (*s s*) opposed to the plates of the other valve.

Oral lamellæ have been detected by Mr. Salter in *P. liratus;* in *P.* ? *brevirostris* (Devonian, Newton) the dorsal valve has a long trough-like process supported by a single low septum.

Fossil, 20 sp. Arctic America, U. S. Europe.

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* Ventral side of cast, showing the V shaped cavity of the dental plates, and the impressions of branchial veins, accompanied by arteries; (after King.)

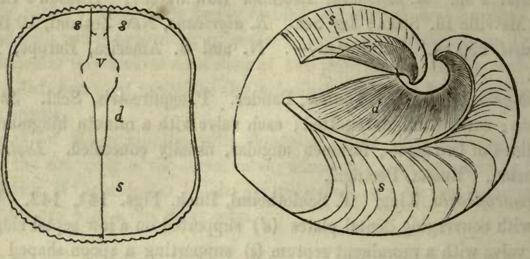

Fig. 143. *Longitudinal;* *Transverse section.*

The relations of the animal to the shell, in such a species as *P. Knightii* can only be inferred by comparison with other species in which the internal plates are less developed, and with other genera, such as *Cyrtia* and *Camarophoria*. In fig. 143, the small central chamber (*v*) must have been occupied by the digestive organs. the large lateral spaces (*d s*) by the spiral arms: it is doubtful whether any muscles were attached to these plates; in *Porambonites* the adductor impression is situated beyond the point to which the dental plates converge, and in *Camarophoria* the muscular impressions occupy the same position as in *Rhynchonella*.

Atrypa, Dalman.

Syn. Cleiothyris, Phillips. Spirigerina, D'Orb.* Hipparionyx, Vanuxem.
Type, A. reticularis, Pl. XV. fig. 17. Figs. 144, 145.

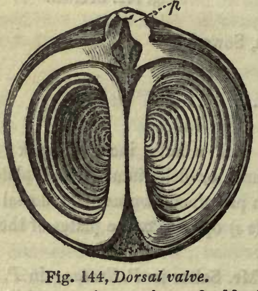

Fig. 144, *Dorsal valve.*

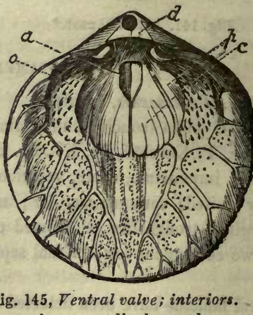

Fig. 145, *Ventral valve; interiors.*

p, hinge-plate; **a,** impressions of adductor muscle; **c,** cardinal muscle **p,** pedicle muscle; **o,** ovarian sinus; **d,** deltidium.

Shell impunctate: oval, usually plaited and ornamented with squamose lines of growth; dorsal valve gibbose; ventral depressed in front; beak small, often closely incurved: foramen round, sometimes completed by a deltidium, often concealed: dorsal valve with a divided hinge-plate, supporting two broad spirally coiled lamellæ; spires vertical, closely appressed, and directed towards the centre of the valve; teeth and impressions like *Rhynchonella.*

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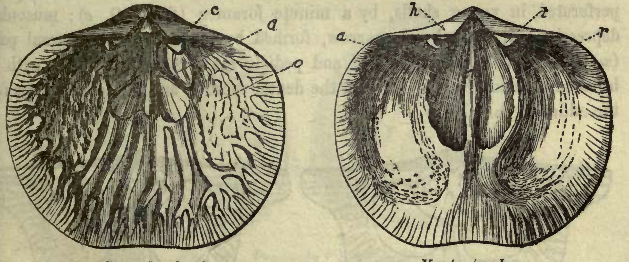
* The term *Atrypa* (*a*, without, *trupa*, foramen) is objectionable, like all Dalman's names; but M. D'Orbigny has made no improvement by proposing *Spirigerina*, in addition to Spirifera, Spirigera, and Spiriferina!

The shells of this genus differ from *Rhynchonella* chiefly in the calcification of the oral supports, a character of uncertain value.

Fossil, 15 sp. L. Silurian — Trias. America (Wellington Channel! Falkland Ids.), Europe, Thibet.

FAMILY IV. ORTHIDÆ.*

Shell transversely oblong, depressed, rarely foraminated; hinge-line wide and straight; beaks inconspicuous; valves plano-convex, or concavo-convex, each with a hinge-area (*h*) notched in the centre; *ventral* valve with prominent teeth (*t*); muscular impressions occupying a saucer-shaped cavity with a raised margin; adductor (*a*) central; cardinal and pedicle impressions (*r*) conjoined, lateral, fan-like: *dorsal* valve with a tooth-like cardinal-process between two curved brachial processes (*c*); adductor impression (*a*) quadruple: vascular impressions consisting of six principal trunks in the dorsal valve, two in the ventral, the external branches turned outwards and backwards inclosing wide ovarian spaces (*o*). Indications have been observed, in several genera, of horizontally-coiled spiral arms; the space between the valves is often very small. The shell-structure is punctate, except in a few instances, where the original texture is probably obliterated.



Dorsal valve.† *Ventral valve.*

Fig. 147. *Orthis, striatula. Devonian, Eifel.*

ORTHIS, Dalman.

Etym. Orthos, straight. *Type,* O. rustica, Pl. XV. fig. 23.

Syn. Dicœlosia (biloba) King. Platystrophia (biforata) King. Gonambonites (inflexa) Pander. Orthambonites (calligramma) Pander.

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* The names of the Families are formed from those of the *typical* genera, by substituting *idæ* for the last syllable of the genitive case.

† From a specimen presented by M. De Koninck to the British Museum; internal casts of this fossil were called *hysterolites* by old authors.

Shell transversely oblong, radiately striated or plaited, bi-convex, hinge-line narrower than the shell, cardinal process simple, brachial processe tooth-like, prominent and curved.

Fossil, 100 sp. L. Silurian — Carb. Arctic America, U.S. S. America Falkland Ids. Europe, Thibet.

? *Sub-genera, Orthisina,* D'Orb. O. anomala, Schl. Fig. 148. *Syn* Pronites (ascendens) and Hemipronites, Pander. *Shell* impunctate ? wides at the hinge-line; cardinal notch closed, byssal notch (*fissure*) covered by a convex pseudo-deltidium, sometimes perforated by a small round foramen. *Fossil.* L. Silurian, Europe.

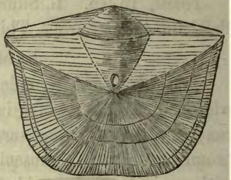
Fig. 148, *Orthisina.*

O. pelargonatus (Streptorhynchus, King) from the Magnesian limestone, *O. senilis,* Carb limestone, and some Devonian species, have the beak twisted, as it if had been attached; there is no foramen.

STROPHOMENA, Blainville.*

Etym. Strophos bent, *mene* crescent.

Ex. S. rhomboidalis, Pl. XV. fig. 24. (= Leptæna depressa, Sby.)

Syn. Leptæna (depressa) Dalman. Leptagonia, M'Coy. Enteletes, Fischer.

Shell semi-circular, widest at the hinge-line, concavo-convex, depressed, radiately striated; area double; ventral valve with an angular notch, progressively covered by a convex pseudo-deltidium; umbo depressed, rarely (? perforated, in young shells, by a minute foramen (fig. 149, *e*); muscula depressions 4, central pair narrow, formed by the adductor: external pai (*m*) fan-like, left by the cardinal and pedicle muscles; *dorsal* valve with bi-lobed cardinal process, between the dental sockets, and four depressions fo the adductor muscle.

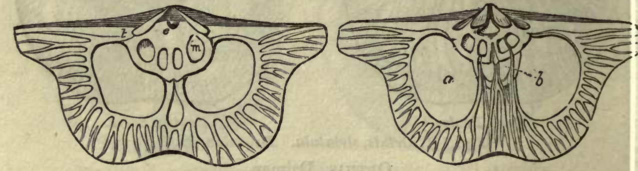

Fig. 149. *Ventral valve.* *Dorsal valve.*
Interior of S. analoga, Carb. limestone (after King).
e, foramen; *t*, teeth; *o*, ovarian spaces; *b*, brachial pits?

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* The name *Strophomena* (rugosa) was originally given by Rafinesque to som unknown or imaginary fossil; it has, however, been adopted both in America an Europe for the group typified by *S. alternata* and *planumbona.*

There are no apparent brachial processes in the dorsal valve of *Strophomena,* and it is possible that the spiral arms may have been supported at some point near the centre of the shell (*b*) as in *Producta; S. rhomboidalis* occasionally exhibits traces of spiral arms, in the ventral valve. *S. latissima* Bouch. has plain areas, like *Calceola.*

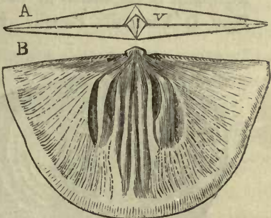


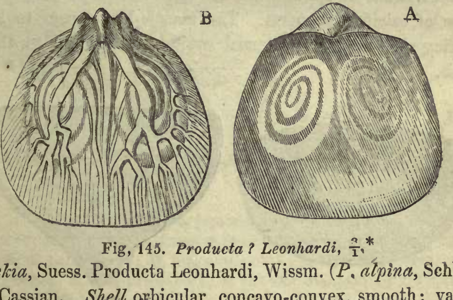
Fig. 150. *Leptæna.* $\frac{2}{1}$
A, hinge areas; v, ventral. B, interior of dorsal valve.

The valves of the Strophomenas are nearly flat until they approach their full growth, they then bend abruptly to one side; the dorsal valve becomes concave in S. alternata and rhomboidalis, whilst in S. planumbona and euglypha it becomes convex; these distinctions are not even sub-generic.

Fossil, 100 sp. L. Silurian — Carb. N. America, Europe, Thibet.

S. demissa, Conr. (Stropheodonta, Hall). *S. Dutertrii,* and several other species have a denticulated hinge-line.

Sub-genera ? *Leptæna* (part) Dalman. L. transversalis, fig. 150. (Plectambonites, Pander.) Valves regularly curved; dorsal concave, thickened, muscular impressions elongated. *Fossil,* L. Silurian —Lias. N. America, Europe. The lias Leptænas resemble *Thecidia* internally; they are free shells, with sometimes a minute foramen at the apex of the triangular deltidium; *L. liassina,* Pl. XV. fig. 25.



Fig, 145. *Producta ? Leonhardi,* $\frac{2}{1}$.*

Koninckia, Suess. Producta Leonhardi, Wissm. (*P. alpina,* Schl.) fig. 145. Trias, St. Cassian. *Shell* orbicular, concavo-convex, smooth; valves articulated ? closely appressed; ventral valve convex, dorsal concave; beak incurved, no hinge-area nor foramen ? interior of each valve furrowed by two spiral lines of four volutions, directed inwards, and crossing the vascular impressions; umbo with 3 diverging ridges. The small spiral cavities, once occupied by the arms, and now filled with spar, may be seen in specimens with both valves, by holding them to the light. Mr. Suess of Vienna states that he has found traces of very slender spiral lamellæ occupying the furrows. This curious little shell most resembles the Triassic *Leptæna dubia* (Producta) Münster (= *Crania Murchisoni*, Klipst. !)

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* A, Translucent specimen; B, interior of dorsal valve.

DAVIDSONIA, Bouchard.

Dedicated to the author of the Monograph of British Fossil Brachiopoda. *Type*, D. Verneuili, Bouch. Fig. 151. Devonian, Eifel.

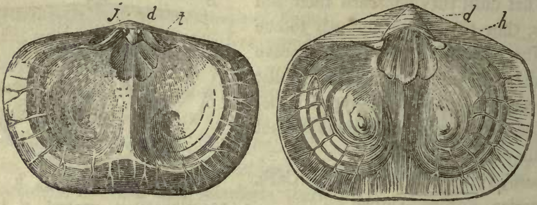

Fig. 151. *Dorsal valve.* *Ventral valve*, $\frac{2}{1}$.

Shell solid, attached by outer surface of the ventral valve to rocks, shells, and corals; valves plain, articulated; *ventral* valve with a wide area (*h*); foramen angular, covered by a convex deltidium (*d*): disk occupied by two conical elevations, obscurely grooved by a spiral furrow of 5-6 volutions; *dorsal valve* with two shallow lateral cavities; vascular impressions consisting of two principal sub-marginal trunks, in each valve, with diverging branches; cardinal and adductor impressions distinct. The furrowed cones undoubtedly indicate the existence of spiral arms, similar to those of *Atrypa* (fig. 144), but destitute of calcified supports. The mantle-lobes seem to have continued depositing shell until the internal cavity was reduced to the smallest possible limit.

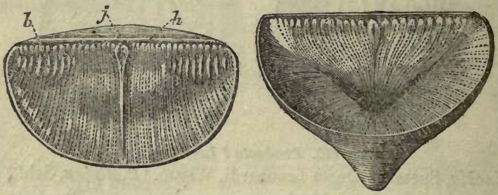

Fig. 152. *Dorsal valve.* *Ventral valve.*

? CALCEOLA, Lamarck.

Etym. Calceola, a slipper. *Type*, C. sandalina, Pl. XV. fig. 26. Fig. 152.

Shell thick, triangular; valves plain, not articulated: *ventral* valve pyramidal; area large, flat, triangular, with an obscure central line; hinge-line straight, crenulated, *dorsal* valve flat, semi-circular, with a narrow area (*h*), a small cardinal process (*j*), and two lateral groups of small apophysary (?) ridges (*b*); internal surface punctate-striate. *Fossil*, Devonian, Eifel, Brit.

he supposed Carboniferous species (*Hypodema*, D.K.) is, perhaps, related o *Pileopsis*. *Calceola* is shaped like *Cyrtia*, and its hinge-area resembles hat of some Strophomenas.

FAMILY V. PRODUCTIDÆ.

Shell concavo-convex, with a straight hinge-line; valves rarely articuated by teeth; closely appressed, furnished with tubular spines; ventral alve convex; dorsal concave; internal surface dotted with conspicuous, unnel-shaped punctures; *dorsal* valve with a prominent cardinal process; rachial processes (?) sub-central; vascular markings lateral, broad and imple; adductor impressions dendritic, separated by a narrow central ridge; *entral* valve with a slightly notched hinge-line; adductor scar central, near he umbo; cardinal impressions lateral, striated.

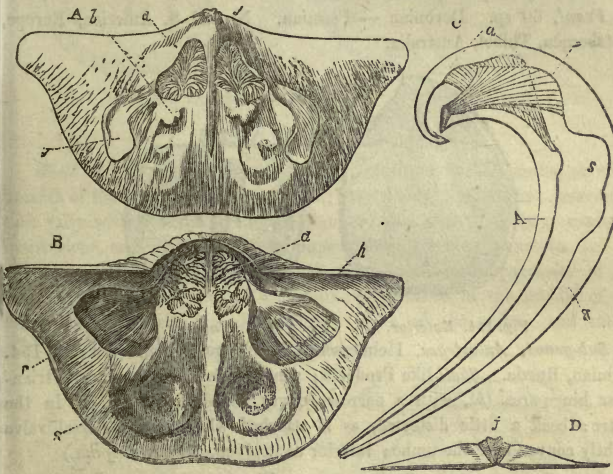

Fig. 153. *Producta gigantea*, ¼ *Carb. limestone.*
A, interior of dorsal valve; B, interior of ventral valve, with the umbo removed; , ideal section of both valves; D, hinge-line of A; *j*, cardinal process; *a*, adductor; , cardinal muscles; *b*, oral processes ?; *s*, hollows occupied by the spiral arms; *v*, ascular impressions; *h*, hinge-area.

PRODUCTA, Sowerby.

Type, P. gigantea, Sby, = *Anomia producta*, Martin.

Ex. P. horrida, Pl. XV. fig. 27. P. proboscidea, Pl. XV. fig. 28.

Shell free, auriculate, beak large and rounded; spines scattered; hinge rea in each valve linear, indistinct; no hinge-teeth; cardinal process lobed, triated; vascular impressions simple, curved; ventral valve deep, with two ounded or sub-spiral cavities in front. These shells may have been attached by a pedicle when young, the impressions of the pedicle-muscle blending with those of the hinge-muscles (*c*) in the ventral valve. A few species appear to have been permanently fixed. *P. striata* is irregular in its growth, elongated and tapering towards the beak, and occurs in numbers packed closely together. *P. proboscidea* seems to have lived habitually in cavities, or half-buried in mud, as suggested by M. D'Orbigny; its ventral valve is prolonged several inches beyond the other, and has its edges rolled together and united, forming a large permanently open tube for the brachial currents. The large spines are most usually situated on the ears of the ventral valve, and may have served to moor the shell; being tubular they were permanently susceptible of growth and repair. Although edentulous, the dorsal valve must have turned on its long hinge-line with as much precision as in those genera which are regularly articulated by teeth.

Fossil, 60 sp. Devonian — Permian. N. and S. America, Europe, Spitzbergen, Thibet, Australia.

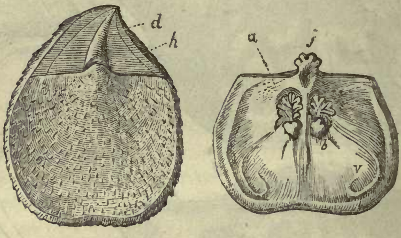

Fig. 154. *Exterior.* *Interior.*

Sub-genus, Aulosteges, Helmersen. A. Wangenheimii, Vern. fig. 154. Permian, Russia. *Shell* like Producta; ventral valve with a large flat triangular hinge-area (*h*), with a narrow convex pseudo-deltidium (*d*) in the centre: beak a little distorted, as if attached when young; dorsal valve slightly convex near the umbo; interior as in *Producta* (*longi-spina.*)

STROPHALOSIA, King.

Ex. S. Morrisii, King. fig. 155.

Syn. Orthothrix, Geinitz.

Shell attached by the umbo of the ventral valve; sub-quadrate; covered with long slender spines; valves articulated, dorsal moderately concave, ventral convex, each with a small area; fissure covered; vascular impressions conjoined, reniform.

Fossil, 8 sp. Devonian — Trias. Europe; Himalaya (Gerard).

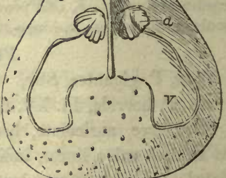

Fig. 155. *S. Morrisii.*

CHONETES, Fischer.

Ex. C. striatella, Pl. XV. fig. 29. *Etym. Chone,* a cup.

Shell transversely oblong, with a wide and straight hinge-line; area double; valves radiately striated, articulated; hinge-margin of ventral valve with a series of tubular spines; fissure covered; interior punctate-striate; vascular impressions (*v*) very small. (*Davidson*).

Fossil, 24 sp. Silurian — Carboniferous. Europe, N. America, Falkland Ids.

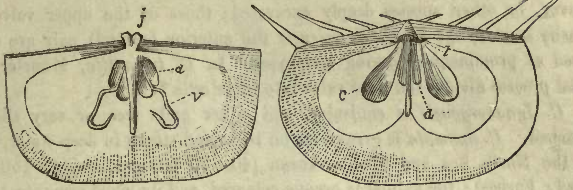

Fig. 156. *Dorsal valve.* *Ventral valve.**

FAMILY VI. CRANIADÆ.

Shell orbicular, calcarious, hinge-less; attached by the umbo, or whole breadth of the ventral valve, rarely free; dorsal valve limpet-like; interior of each valve with a broad granulated border; disk with four large muscular impressions, and digitated vascular impressions; structure punctate.

Animal with free spiral arms, directed towards the concavity of the dorsal valve, and supported by a nose-like prominence in the middle of the lower valve; mantle extending to the edges of the valves, and closely adhering, its margins plain. (Fig. 159.)

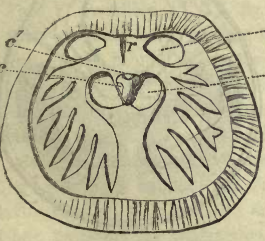

Fig. 157. *Ventral valve.*

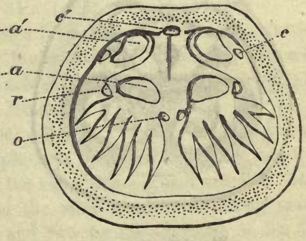

Fig. 158. *Dorsal valve.*

Crania anomala, Muller. $\frac{2}{1}$ *Zetland.*

a, anterior adductors; *a'*, posterior adductors; *c*, protractor sliding muscles; *c'*, cardinal muscle, *r*, *o*, retractor sliding muscles.

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* Interiors of two sp. of *Chonetes* from Nehou and the Eifel, after Davidson; *a*, adductor: *c*, cardinals.

CRANIA, Retzius.

Etym. Kraneia, capitate. *Type,* Anomia craniolaris, L.

Ex. C. Ignabergensis, Pl. XV. fig. 30. C. anomala, figs. 157—159.

Syn. Criopus, Poli. Orbicula (anomala) Cuvier, = O. Norvegica, Lam.

Shell smooth or radiately striated; umbo of dorsal valve sub-central: of ventral valve sub-central, marginal, or prominent and cap-like, with an obscure triangular area traversed by a central line.

The large muscular impressions of the attached valve are sometimes convex, in other species deeply excavated; those of the upper valve are usually convex, but in *C. Parisiensis* the anterior (central) pair are developed as prominent diverging apophyses. In *C. tripartita,* Münster, the nasal process divides the fixed valve into three cells.*

C. Ignabergensis is equivalve, and either quite free or very slightly attached. *C. anomala* is gregarious on rocks and stones in deep water, both in the North Sea and Mediterranean (40—90 fathoms, *living;* 150 fms. *dead;* Forbes): the animal is orange-coloured, and its labial arms are thick, fringed with cirri, and disposed in a few horizontal gyrations (fig. 159.)

Distr. 5 sp. Spitzbergen, Brit. Medit. India, New S. Wales. — 150 fms.

Fossil, 28 sp. L. Silurian —. Europe.

C. antiquissima, Eichw. (Pseudo-crania M'Coy) is free, and has the internal border of the valves smooth; the branchial impressions blend in front. *Spondylobolus craniolaris,* M'Coy, is a small and obscure fossil, from the L. Silurian shale of Builth. The upper valve appears to have been like *Crania,* the lower to have had a small grooved beak, with blunt, tooth-like processes at the hinge-line.

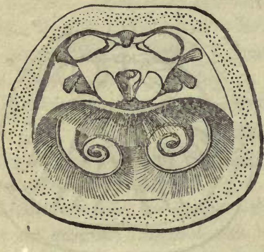

Fig. 159. *Crania.*†

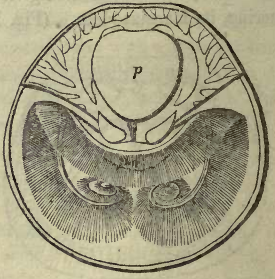

Fig. 160. *Discina.*‡

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* M. Quenstedt has placed the Oolitic Cranias in *Siphonaria!*

† Dorsal valve with the animal, seen by removing the mantle.

‡ The animal as seen on the removal of part of the lower mantle-lobe, the extremities of the labial arms are displaced forwards, in order to show their spiral terminations: *p,* is the expanded surface of the pedicle; the mouth is concealed by the overhanging cirri. The mantle-fringe is not reprĕsented.

FAMILY VII. Discinidæ.

Shell attached by a pedicle, passing through a foramen in the ventral valve; valves not articulated; minutely punctate.

Animal with a highly vascular mantle, fringed with long horny setæ: oral arms curved backwards, returning upon themselves, and ending in small spires directed downwards, towards the ventral valve.

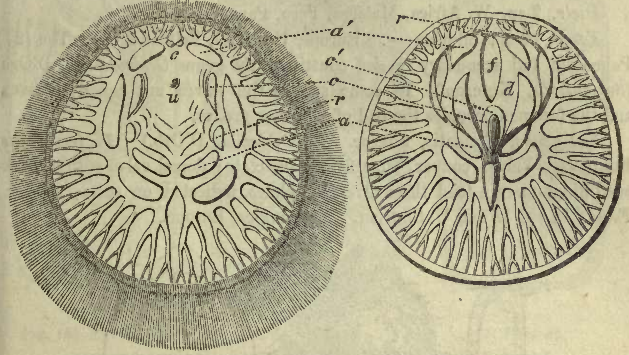

Fig. 161. *Dorsal.* Fig. 162. *Ventral lobe.*

Discina lamellosa, Brod. $\frac{2}{1}$.

u, umbo; *f,* foramen; *d,* disk; *a,* anterior adductors; *a'*, posterior adductors; *c, c'*, protractor sliding muscles; *r,* retractor muscles. The mantle-fringe is not represented in fig. 162.

Discina, Lamarck.

Syn. Orbicula, Sby (not Cuvier*). Orbiculoidea (elliptica) D'Orb.

Type, D. lamellosa, Pl. XV. fig. 31. (= D. ostreoides, Lam.)

Shell orbicular, horny; upper valve limpet-like, smooth or concentrically lamellose, apex behind the centre; lower valve flat or conical, with a sunk and perforated disk on the posterior side; interior polished; lower valve with a central prominence in front of the foramen.

Animal transparent; mantle lobes distinct all round; labial folds united, not extensile; alimentary canal simple, bent upon itself ventrally, and terminating between the mantle-lobes on the right side. There are four distinct adductor muscles, as in *Crania;* and the same number of sliding muscles, viz. two pairs for the protraction and two for the retraction of the dorsal valve, but some of these are probably inserted in the pedicle. The oral cirri are extremely tender and flexible, contrasting with the stiff and brittle setæ of the mantle, which are themselves more like the bristles of certain annelides (e. g. the sea-mouse, *Aphrodite*). The relation of the animal to the perforate and imperforate valves is shown to be the same as in *Terebratula*, by the labial fringe; but the only process which can *possibly* have afforded support to the oral arms, is developed from the centre of the ventral valve, as in *Crania*. Baron Ryckholt has represented a Devonian fossil from Belgium, with a fringed border; but if this shell is the *Crania obsoleta* of Goldfuss, the fringe must belong to the shell, and not to the mantle.

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* The *Orbicula* of Cuvier was the *Patella anomala,* Müll (= Crania) as pointed out by Dr. Fleming, in the "History of British Animals," 1828.

Distr. 7 sp. W. Africa, Malacca, Peru, Panama.

Fossil, 29 sp. Silurian —. Europe, U. States, Falkland Ids. The (27) Palæozoic and secondary species constitute the genus *Orbiculoidea*, D'Orb. (*Schizotreta*, Kutorga.) In some species the valves are equally convex, and the foramen occupies the end of a narrow groove.

Sub-genus, Trematis, Sharpe. (= Orbicella, D'Orb.) *T. terminalis*, Emmons. Valves convex, superficially punctate; dorsal valve with a thickened hinge-margin (and three diverging plates, indicated on casts; *Sharpe*.) *Fossil*, 14 sp. L. and U. Silurian. N. America, Europe.

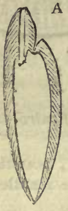

Fig. 163.

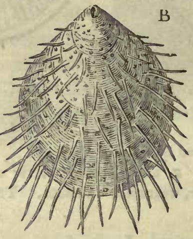

Fig. 164. *Exterior*.

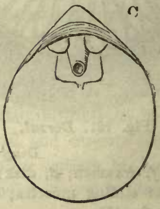

Fig. 163, a, *Interior*.

SIPHONOTRETA, Verneuil.

Etym. Siphon a tube, *tretos* perforated.

Types, S. unguiculata, Eichw. fig. 163, 163, a. S. verrucosa, fig. 164.

Shell oval, bi-convex, slightly beaked, conspicuously punctate, or spiny; beak perforated by a tubular foramen; hinge-margins thickened; ventral valve with four close adductor scars surrounding the foramen. The spines are tubular, and open into the interior of the shell by prominent orifices. (*Carpenter*.) *S. anglica*, Morris, has moniliform spines.

Fossil, 6 sp. L. and U. Silurian. Brit. Bohemia, Russia.

? *Acrotreta* (sub-conica) Kutorga, L. Silurian, Russia. Shaped like *Cyrtia*, with an apical foramen; no hinge.

FAMILY VIII. LINGULIDÆ.

Shell oblong or orbicular, sub-equivalve, attached by a pedicle passing out between the valves; texture horny, minutely tubular.

Animal with a highly vascular mantle, fringed with horny setæ; oral arms thick, fleshy, spiral, the spires directed inwards, towards each other; valves opened and closed by sliding muscles.

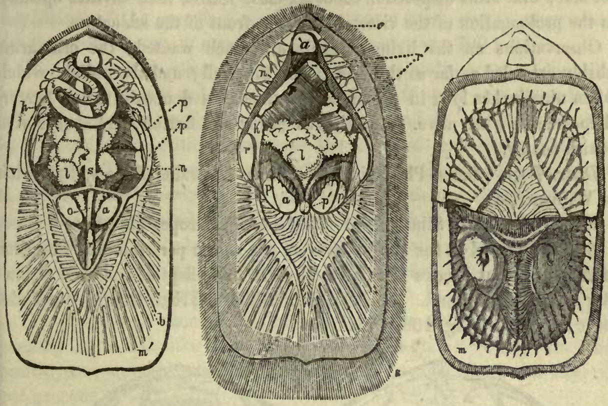

Fig. 165. *Dorsal.** 166. *Ventral.* 167. *Ventral.*

Lingula anatina, Lam (original). *Syn.* Patella unguis, L. (part.)

a a, anterior adductors; *a'*, posterior adductor; *p p*, external protractors; *p'p'*, central protractors; *r r*, anterior retractors; *r'r'r'*, posterior retractors; *c*, capsule of pedicle; *n n*, visceral sheath; *o*, œsophagus; *s*, stomach; *l*, liver; *i*, intestine; *v*, vent; *h h*, auricles; *h'*, left ventricle; *b*, branchial vessels; *m'*, mantle margin; *m*, inner lamina of mantle-margin retracted, showing bases of setæ; *s*, setæ.

LINGULA, Bruguière.

Etym. Lingula, a little tongue. *Type*, L. anatina, Pl. XV. fig. 32.

Shell oblong, compressed, slightly gaping at each end, truncated in front, rather pointed at the umbones; dorsal valve rather shorter, with a thickened hinge-margin, and a raised central ridge inside.

Animal with the mantle-lobes firmly adhering to the shell, and united to the epidermis, their margins distinct, and fringed all round; branchial veins giving off numerous free, elongated, narrow loops from their inner surfaces; visceral cavity occupying the posterior half of the shell, and surrounded by a strong muscular sheath; pedicle elongated, thick; adductor muscles 3, the posterior pair combined; two pairs of retractors, the posterior pair unsymmetrical, one of them dividing; protractor sliding muscles, two pairs; stomach long and straight, sustained by inflections of the visceral sheath; intestine convoluted dorsally, terminating between the mantle-lobes on the right side; oral arms disposed in about six close whirls, their cavities opening into the prolongation of the visceral sheath in front of the adductors.

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* In fig 165 a small portion of the liver and visceral sheath have been removed, to show the course of the stomach and intestine. In some specimens the whole of the viscera, except a portion of the liver, are concealed by the ovaries. In fig. 167, the front half of the ventral mantle-lobe is raised, to show the spiral arms; the black spot in the centre is the mouth, with its upper and lower lips, one fringed, the other plain. The mantle-fringe has been omitted in figs. 165-7.

Observations on the living Lingula are much wanted; the oral arms probably extended as far as the margins of the shell; and the pedicle, which is often nine inches long in preserved specimens, is doubtless much longer, and contractile when alive. The shell is horny and flexible, and always of a greenish colour.

Distr. 7 sp. India, Philippines, Moluccas, Australia, Feejees, Sandwich Ids. W. America.

Fossil, 34 sp. L. Silurian —. N. America, Europe, Thibet.

Lingulæ existed in the British Seas as late as the period of the Coralline Crag. The recent species have been found at small depths, and even at low-water half buried in sand. *L. Davisii*, L. Silurian, Tremadoc, has a pedicle-groove like *Obolus*, fig. 168. (Salter).

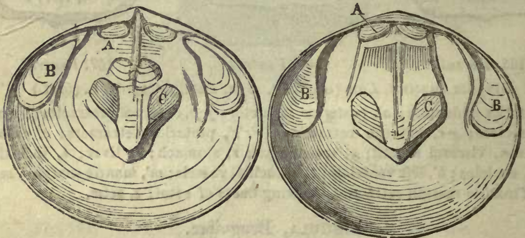

Fig. 168. *Ventral valve.* Fig. 169. *Dorsal valve.*
Obolus Davidsoni (Salter). Wenlock limestone, Dudley.
A, posterior adductors; B, sliding muscles; C, Anterior adductors.
The *pedicle-scar* in the centre of fig. 168 has no letter.

OBOLUS, Eichwald.

Syn. Ungula, Pander; Aulonotreta, Kutorga.

Etym. Obolus, a small Greek coin. *Type*, O. Apollinis, Eichw.

Shell orbicular, calcario-corneous, depressed, sub-equivalve, smooth; hinge-margin thickened inside, and slightly grooved in the ventral valve; posterior adductor impressions separate; anterior pair sub-central; impressions of sliding-muscles lateral. Fig. 168, 169 (after Davidson.)

Fossil, 4 sp. L. and U. Silurian. Sweden, Russia, England, U. States.

CLASS V. CONCHIFERA, LAMARCK.

(*Lamelli-branchiata*, Blainville.)

The bivalve shell-fish, or *Conchifera*, are familiar to every one, under the form of oysters, scallops, mussels, and cockles.* They come next to the univalves (*gasteropoda*) in variety and importance, and though less numerous specifically, are far more abundant individually.† The bivalves are all aquatic, and excepting a few widely-dispersed and prolific genera, are all inhabitants of the sea; they are found on every coast, and in every climate, ranging from low-water mark to a depth of more than 200 fathoms.

In their native element the Oyster and Scallop lie on one side, and the lower valve is deeper and more capacious than the upper; in these the foot is wanting, or else small, and not used for locomotion. Most other bivalves live in an erect position, resting on the edges of their shells, which are of equal size. Those which move about much, like the river-mussel, maintain themselves nearly horizontally,‡ and their keel-shaped foot is adapted for ploughing through sand or mud. The position of those bivalves which live half-buried in river-beds or at the bottom of the sea, is often indicated by the darker colour of the part exposed; or by deposits of tufa, or the growth of sea-weed on the projecting ends of the valves.

In *Nucula* and some others the foot is deeply cleft, and capable of expanding into a disk, like that on which the snails glide: whilst in the mussel, pearl-oyster, and others which habitually spin a *byssus*, the foot is finger-like and grooved.

The burrowing species have a strong and stout foot with which they bore vertically into the sea-bed, often to a depth far exceeding the length of their valves; these never voluntarily quit their abodes, and often become buried and fossilized in them. They most usually burrow in soft ground, but also in coarse gravel, and firm sands and clays; one small *modiola* makes its hole in the cellulose tunic of Ascidians, and another in floating blubber.

The boring shell-fish have been distinguished from the mere burrowers, perhaps without sufficient reason, for they are found in substances of every degree of hardness, from soft mud to compact limestone, and the method employed is probably the same. §

The means by which bivalves perforate stone and timber has been the subject of much inquiry, both on account of its physiological interest, and the desire to obtain some remedy for the injuries done to ships and piers and breakwaters. The ship-worm (*teredo*) and some allied genera, perforate timber only; whilst the *pholas* bores into a variety of materials, such as chalk, shale, clay, soft sandstone and sandy marl, and decomposing *gneiss;** it has also been found boring in the peat of submarine forests, in wax, and in amber.† It is obvious that these substances can only be perforated alike by *mechanical* means; either by the foot or by the valves, or both together, as in the burrowing shellfish. The *pholas* shell is rough, like a file, and sufficiently hard to abrade limestone; and the animal is able to turn from side to side, or even quite round in its cell, the interior of which is often annulated with furrows made by the spines on the front of the valves. The foot of the *pholas* is very large, filling the great anterior opening of the valves; that of the ship-worm is smaller, but surrounded with a thick collar, formed by the edges of the mantle, and both are armed with a strong *epithelium.* The foot appears to be a more efficient instrument than the shell in one respect, inasmuch as its surface may be renewed as fast as it is worn away.‡ (*Hancock.*)

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* They are the *Dithyra* of Aristotle and Swainson, and constitute the second or sub-typical group in the quinary system.

† It has been stated that the predatory *mollusca* are more numerous than the vegetable-feeders; but it is not so with the individuals constituting the species.

‡ This is the position in which they are always figured in English books, being best suited for the comparison of one shell with another.

§ See the admirable memoir by Mr. Albany Hancock, in the An. Nat. Hist. for October, 1848.

The mechanical explanation becomes more difficult in the case of another set of shells, *lithodomus, gastrochæna, saxicava,* and *ungulina,* which bore only into calcarious rocks, and attack the hardest marble, and still harder shells (fig. 25, p. 42). In these the valves can render no assistance, as they are smooth, and covered with *epidermis;* neither does the foot help, being small and finger-like, and not applied to the end of the burrow. Their power of movement also is extremely limited, their cells not being cylindrical, whilst one of them, *saxicava,* is fixed in its crypt by a *byssus.* These shell fish have been supposed to dissolve the rock by chemical means (*Deshayes*), or else to wear it away with the thickened anterior margins of the mantle. (*Hancock.*) §

The holes of the *lithodomi* often serve to shelter other animals after the death of the rightful owners; species of *Modiola*, *Arca*, *Venerupis*, and *Coralliophaga*, both recent and fossil, have been found in such situations, and mistaken for the real miners.*

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* There is a specimen from the coast of France, in the Brit. Museum.

† Highgate resin, in the cabinet of Mr. Bowerbank.

‡ The final polish to some steel goods is said to be given by the *hands* of workwomen. In Carlisle Castle they point to the rude impression of a hand on the dungeon wall, as the work of FERGUS M'IVOR, in the two years of his solitary imprisonment.

§ All attempts to detect the presence of an acid secretion have hitherto failed, as might be expected; for the hypothesis of an acid solvent supposes only a very feeble but continuous action, such as in nature always works out the greatest results in the end. See Liebig's Organic Chemistry, and Dumas and Boussingault on the "Balance of Organic Nature." Intimately connected with this question are several other phenomena; the removal of portions of the interior of univalves, by the animal itself, as in the genera *Conus, Auricula,* and *Nerita* (fig. 24, p. 40); the perforation of shells by the tongues of the carnivorous gasteropods and the formation of holes in wood and limestone by limpets. Some facts in surgery also illustrate this subject, (1) dead bone is removed when granulations grow into contact with it: (2) if a hole is bored in a bone, and an ivory peg driven into it, and covered up, so much of the peg as is imbedded in the bone will be removed. (*Paget.*) The "absorption" of the fangs of milk-teeth, previous to shedding, is well-known. In these cases the removal of the bone earth is effected without the development of an acid, or other disturbance of the neutral condition of the circulating fluid.

The boring shellfish have been called "stone-eaters" (*lithophagi*) and "wood-eaters" (*xylophagi*), and some of them at least are obliged to swallow the material produced by their operations, although they may derive no sustenance from it. The ship-worm is often filled with pulpy, impalpable sawdust, of the colour of the timber in which it worked. (*Hancock.*) No shellfish deepens or enlarges its burrow after attaining the full-growth usual to its species (p. 43).

The bivalves live by filtering water through their gills.† Whatever particles the current brings, whether organic or inorganic, animal or vegetable, are collected on the surface of the breathing-organ and conveyed to the mouth. In this manner they help to remove the impurities of turbid water.‡ The mechanism by which this is effected may be most conveniently examined in a bivalve with a closed mantle, like the great *Mya* (fig. 170), which lives in the mud of tidal rivers, with only the ends of its long combined siphons exposed at the surface.§ The siphons can be extended twice the length of the shell, or drawn completely within it; they are separated, internally, by a thick muscular wall. The branchial siphon (*s*) has its orifice surrounded by a double fringe; the exhalent siphon (*s'*) has but a single row of tentacles; these organs are very sensitive, and if rudely touched the orifices close and the siphon itself is rapidly withdrawn. When unmolested, a current flows steadily into the orifice of the branchial siphon, whilst another current rises up from the exhalent tube. There is no other opening in the mantle except a small slit in front (*p*) through which the foot is protruded. The body of the animal occupies the centre of the shell (*b*), and in front of it is the mouth (*o*) furnished with an upper and a lower lip, which are prolonged on each side into a pair of large membranous palpi (*t*). The gills (*g*) are placed two on each side of the body, and are attached along their upper, or dorsal margins; behind the body they are united to each other and to the siphonal partition. Each gill is composed of two laminæ, divided internally into a series of parallel tubes, indicated outside by transverse lines; these tubes open into longitudinal channels at the base of the gills, which unite behind the posterior adductor muscle at the commencement of the exhalent siphon (*c*). Examined by the microscope, the gill laminæ appear to be a network of blood-vessels whose pores opening into the gill-tubes, are fringed with vibratile *cilia.* These microscopic organs perform most important offices; they create the currents of water, arrest the floating particles, and mould them, mixed with the viscid secretion of the surface, into threads, in the furrows of the gill, and propel them along the grooved edge of its free margin, in the direction of the mouth; they are then received between the palpi in the form of ravelled threads. (*Alder* and *Hancock.*)

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* Fossil univalves (*trochi*) occupying the burrows of a *pholas*, were discovered by Mr. Bensted in the Kentish-rag of Maidstone. See Mantell's Medals of Creation. M. Buvignier has found several species of *Arca* fossilized in the burrows of *lithodomi*.

† It seems scarcely necessary to remark that the bivalves do not feed upon prey caught between their valves. Microscopists are well aware that sediment taken from the alimentary canal of bivalve shellfish contains the skeletons of animalcules and minute vegetable organisms, whose geometrical forms are remarkably varied and beautiful; they have also been obtained (in greater abundance than ordinary) from mud filling the interior of fossil oyster-shells.

‡ When placed in water coloured with indigo, they will in a short time render it clear, by collecting the minute particles and condensing them into a solid form.

§ Alder and Hancock on the branchial currents of *Pholas* and *Mya*. An. Nat. Hist. Nov. 1851.

In *Mya*, therefore (and in other burrowers), the cavity of the shell forms a closed branchial chamber, and the water which enters it by the respiratory siphon can only escape by passing through the gills into the dorsal channels, and so into the exhalent siphon. In the river-mussel the gills are not united to the body, but a slit is left by which water might pass into the dorsal channel, were it not for the close apposition of the parts under ordinary circumstances (fig. 171, *b*). The gills of the oyster are united throughout, by their bases, to each other and to the mantle, completely separating the branchial cavity from the *cloaca*. In *Pecten* the gills and mantle are free, but the "dorsal channels" still exist, and carry out the filtered water.

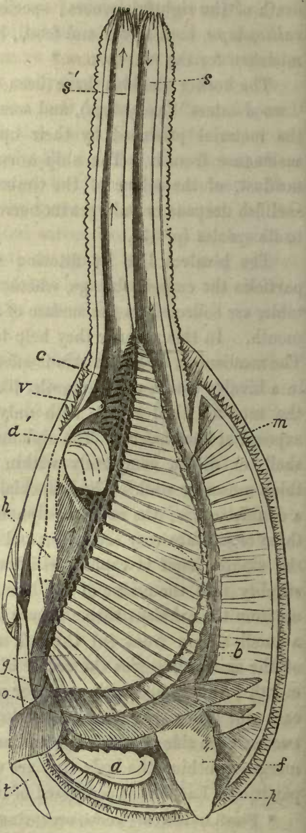

Fig. 170. *Mya arenaria.**

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* *Mya arenaria*, L. (original, from specimens obtained at Southend, and communicated by Miss Hume). The left valve and mantle lobe and half the siphons are removed. *a, a'*, adductor muscles; *b*, body; *c*, cloaca; *f*, foot; *g*, branchiæ; *h*, heart; *m*, cut edge of the mantle; *o*, mouth; *s, s'*, siphons; *t*, labial tentacles; *v*, vent. The arrows indicate the direction of the currents; the four rows of dots at the base of the gills are the orifices of the branchial tubes, opening into the dorsal channels.

In some genera the gills subserve a third purpose; the oviducts open into the dorsal channels. and the eggs are received into the gill-tubes and retained there until they are hatched. In the river-mussel the outer gills only receive the eggs, with which they are completely distended in the winter months (Fig. 171, *o*, *o*). In *Cyclas* the inner gills form the *marsupium*, and only from 10 to 20 of the fry are found in them at one time; these remain until they are nearly a quarter the length of the parent.*

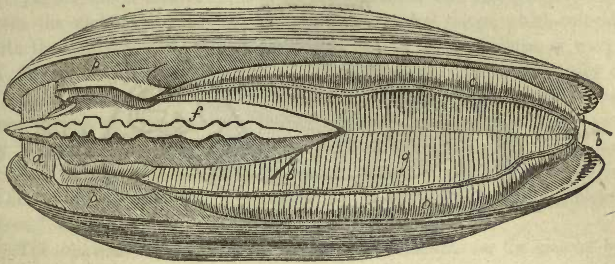

Fig. 171. River-mussel. (*Anodon cygneus* ♀)†

The *valves of the Conchifera* are bound together by an elastic *ligament*, and articulated by a hinge furnished with interlocking teeth. The shell is closed by powerful adductor muscles, but opens spontaneously by the action of the ligament, when the animal relaxes, and after it is dead.

Each valve is a hollow cone, with the apex turned more or less to one side; the apex is the point from which the growth of the valve commences, and is termed the beak, or *umbo* (p. 37.) The beaks (*umbones*) are near the hinge, because that side grows least rapidly, sometimes they are quite marginal; but they always tend to become wider apart with age. The beaks are either straight, as in *Pecten;* curved as in *Venus;* or spiral, as in *Isocardia* and *Diceras.* In the latter case each valve is like a spiral univalve, especially those with a large aperture and small spire, such as *Concholepas*; it is the left valve which resembles the ordinary univalve, the right valve being a *left-handed spiral* like the reversed gasteropods. When one valve is spiral and the other flat, as in *Chama ammonia* (fig. 185), the resemblance to an operculated spiral univalve becomes very striking (see p. 47).

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* Some other particular respecting the organization and development of bivalve shell-fish are given in the introductory chapter. For an account of their vascular system see Milne-Edwards, An. Sc. Nat. 1847, Tom. VIII. p. 77.

† The valves are forcibly opened and the foot (*f*) contracted; *a*, anterior adductor-muscle, much stretched; *p*, *p*, palpi; *g*, inner gills; *o*, *o*, outer gills distended with spawn; *b*, *b*, a bristle passed through one of the dorsal channels.

The relation of the shell to the animal may be readily determined, in most instances, by the direction of the *umbones*, and the position of the ligament. The umbones are turned towards the front, and the ligament is posterior; both are situated on the back, or dorsal side of the shell. The *length* of a bivalve is measured from the anterior to the posterior side, its *breadth* from the dorsal margin to the base, and its *thickness* from the centres of the closed valves.*

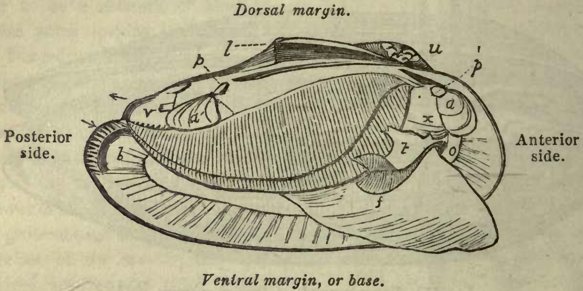

Fig. 172. *Unio pictorum*, L. (original) with the right valve and mantle-lobe removed; *a*, *a*, adductor muscles; *p*. *p*, pedal muscles; *x*, accessory pedal muscle; *u*, umbo; *l*, ligament; *b*, branchial orifice; *v*, anal opening; *f*, foot; *o*, mouth; *t*, palpi.

The *Conchifera* are mostly *equivalve*, the right and left valves being of the same size and shape, except in the *Ostreidæ* and a few others. In *Ostrea*, *Pandora* and *Lyonsia* the right valve is smallest; in *Chamostrea* and *Corbula*, the left; whilst the *Chamaceæ* follow no rule in this respect.

The bivalves are all more or less *inequilateral*, the anterior being usually much shorter than the posterior side. *Pectunculus* is nearly equilateral, and in *Glycimeris* and *Solemya*, the anterior is much longer than the posterior side The front of the smaller Pectens is shewn by the byssal notch; but in the large scallops, oysters and *Spondyli*, the only indication of the position of the animal is afforded by the large internal muscular impression, which is on the *posterior* side. The ligament is sometimes between the umbones, but is never anterior to them. The *siphonal impression*, inside the shell, is always posterior.

Bivalves are said to be *close*, when the valves fit accurately, and *gaping* when they cannot be completely shut. In *Gastrochæna* (Pl. XXIII. fig. 15,) the opening is anterior, and serves for the passage of the foot; in *Mya* it is posterior and siphonal; in *Solen* and *Glycimeris* both ends are open. In *Bysso-arca* (Pl. XVII. fig, 13,) there is a ventral opening formed by corresponding notches in the margin of the valves, which serves for the passage of the byssus; in *Pecten*, *Avicula*, and *Anomia*, (fig. 176 *s*) the byssal notch (or *sinus*) is confined to the right valve.

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* Linnæus and the naturalists of his school, described the front of the shell as the back, the left valve as the right, and *vice versa*. In those works which have been compiled from "original descriptions" (instead of specimens) sometimes one end, sometimes the other, is called *anterior*; and the *length* of the shell is sometimes estimated in the direction of the length of the animal, but just as frequently in a line at right angles to it.

The *surface* of bivalve shells is often ornamented with ribs which *radiate* from the umbones to the margin, or with *concentric* ridges, which coincide with the lines of growth. Sometimes the sculpturing is oblique, or wavy; in *Tellina fabula* it is confined to the right valve. In many species of *Pholas*, *Teredo* and *Cardium* the surface is divided into two areas by a transverse furrow, or by a change in the direction of the ribs. The *lunule* (see fig. 14, p. 26,) is an oval space in *front* of the beaks; it is deeply impressed in *Cardium retusum*, L. *Astarte excavata* and the genus *Opis*. When a similar impression exists behind the beaks it is termed the *escutcheon*.*

The *ligament* of the *Conchifera* forms a substitute for the muscles by which the valves of the *Brachiopoda* are opened. It consists of two parts, the ligament properly so called, and the *cartilage*; they exist either combined or distinct, and sometimes one is developed and not the other. The external ligament is a horny substance, similar to the *epidermis* which clothes the valves; it is usually attached to ridges on the posterior hinge-margins, behind the umbones, and is consequently stretched by the closing of the valves. The ligament is large in the river-mussels, and small in the Mactras and Myas, which have a large internal cartilage; in *Arca* and *Pectunculus* the ligament is spread over a flat, lozenge-shaped area, situated between the umbones, and furrowed with cartilage grooves. In *Chama* and *Isocardia* the ligament splits in front, and forms a spiral round each umbo. The *Pholades* have no ligament, but the anterior adductor is shifted to such a position on the hinge-margin that it acts as a hinge-muscle. (Pl. XXIII, fig. 13.)

The internal ligament, or *cartilage*, is lodged in furrows formed by the ligamental plates, or in pits along the hinge-line; in *Mya* and *Nucula* it is contained in a spoon-shaped process of one or both valves. It is composed of elastic fibres placed perpendicularly to the surfaces between which it is contained, and is slightly iridescent when broken; it is compressed by the closing of the valves, and tends forcibly to open them as soon as the pressure of the muscles is removed. The name *Amphidesma* (double ligament) was given to certain bivalves, on the supposition that the separation of the cartilage from the ligament was peculiar to them. The cartilage-pit of many of the *Anatinidæ* is furnished internally with a moveable ossicle.

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* Only those technical terms which are used in a *peculiar sense* are here referred to; for the rest, any Dictionary may be consulted, especially *Roberts's Etymological Dictionary of Geology*, by Longman and Co.

The ligament is frequently preserved in fossil shells, such as the great Cyprinas and Carditas of the London Clay, the Unios of the Wealden, and even in some lower Silurian bivalves.

All bivalves are clothed with an *epidermis* (*v.* p. 40) which is organically connected with the margin of the mantle. It is developed to a remarkable extent in *Solemya* and *Glycimeris* (Pl. XXII. fig. 13, 17), and in *Mya* it is continued over the siphons and closed mantle-lobes, making the shell appear *internal.*

The *interior* of bivalves is inscribed with characters borrowed directly from the shell-fish, and affording a surer clue to its affinities than those which the exterior presents. The structure of the *hinge* characterizes both families and genera, whilst the condition of the respiratory and locomotive organs may be to some extent inferred from the muscular markings.

The margin of the shell on which the ligament and teeth are situated, is termed the *hinge-line.* It is very long and straight in *Avicula* and *Arca,* very short in *Vulsella,* and curved in most genera. The locomotive bivalves have *generally* the strongest hinges, but the most perfect examples are presented by *Arca* and *Spondylus.* The central teeth, those immediately beneath the *umbo,* are called hinge (or *cardinal*) teeth; those on each side are *lateral* teeth. Sometimes lateral teeth are developed, and not cardinal teeth (*Alasmodon; Kellia*): more frequently the hinge-teeth alone are present. In young shells the teeth are sharp and well-defined; in aged specimens they are often thickened, or even obliterated by irregular growth (*Hippopodium*) or the encroachment of the hinge-line (*Pectunculus*). Many of the fixed and boring shells are *edentulous.**

The *muscular impressions* are those of the adductors, the foot and byssus, the siphons, and the mantle (see p. 26.)

The *adductor impressions* are usually simple, although the muscles themselves may be composed of two elements,† as in *Cytherea chione* (fig. 14, p. 26) and the common oyster. The impression of the posterior adductor in *Spondylus* is double (Pl. XVI. fig. 15). In *Pecten varius* (fig. 173, *a, a,*) large independent impressions are formed by the two portions of the adductor, and in the *left* valve there is a third impression (*p*) produced by the foot, which in the byssiferous pectens is a simple conical muscle with a broad base.

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* The dentition of bivalve shells may be stated thus:—cardinal teeth, 2.3 or $\frac{2}{3}$ —meaning 2 in the *right* valve, 3 in the *left;* lateral teeth 1—1, 2—2, or 1 anterior and 1 posterior in the *right* valve, 2 anterior and 2 posterior lateral teeth in the left valve.

† Compare the shell of *modiola,* Pl. XVII. fig. 5, with the woodcut, fig. 177.

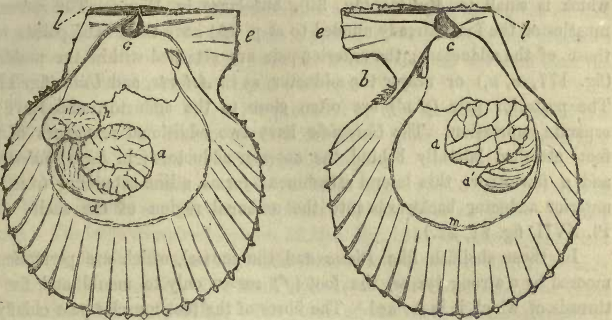

Fig. 173. *Left valve*. (*Pecten varius*): *Right valve*.
a, *a*, adductor; *p*, pedal impression; *m*, pallial line: *l*, ligamental margin; *c*, *c*, cartilage; *e*, *e*, anterior ears; *b*. byssal sinus.

In the *left* valve of *Anomia* there are four distinct muscular impressions (fig. 175). Of these, the small posterior spot alone is produced by the *adductor*, and corresponds with the solitary impression in the right valve.

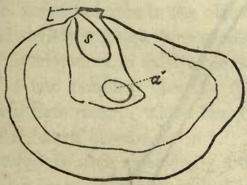

Fig. 176. *Right valve.*

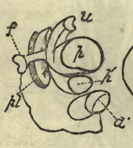

Fig. 174.

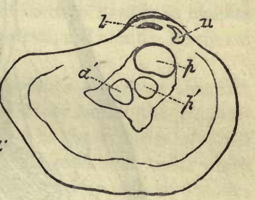

Fig. 175. *Left valve.**

The adductor itself (fig. 174 *a'*) is double. The large central impression (*p*) is produced by the muscle of the *plug* (the equivalent of the *byssal* muscle in *Pinna* and *Modiola*). The small impression within the umbo (*u*) and the third impression in the disk (*p'*) (wanting in *Placunomia*) are caused by the retractors of the foot.

The term *monomyary*, employed by Lamarck to distinguish the bivalves with one adductor, applies only to the *Ostreidæ*, part of the *Aviculidæ*, and to the genera *Tridacna* and *Mülleria*.

The *dimyary* bivalves have a second adductor, near the anterior margin, which is small in *Mytilus* (fig. 30), but large in *Pinna.* The *retractor* muscles of the foot (already alluded to at p. 26) have their fixed points near those of the adductors; the anterior pair are attached within the umbones (fig. 177, *u*, *u*,) or nearer the adductor, as in *Astarte*, and *Unio* (fig. 172). The posterior pair (*p' p'*) are often close to the adductor, and leave no separate impression. The *Unionidæ* have two additional retractors of the foot, attached laterally behind the anterior adductors; in *Leda*, *Solenella*, and a few others, this lateral attachment forms a line extending from the anterior adductor backwards into the umbonal region of the shell. (See Pl. XVII. fig. 21, 22.)

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* Fig. 176. Right valve of *Anomia ephippium*, L. *l*, ligamental process; *s*, sinus. Fig. 175, Left valve; *l*, ligament pit. Fig. 174. Muscular system, from a drawing communicated by A. Hancock, Esq. *f*, the foot; *pl*, the plug. The muscle *p* is generally described as a portion of the *adductor;* but it is certain, from a comparison of this shell with *Carolia* and *Placuna*, that *a'* represents the entire adductor, and *p* the byssal muscle.

In those shellfish like *Pinna* and the mussel, which are permanently moored by a strong *byssus*, the foot (*f*) serves only to mould and fix the threads of which it is formed. The fibres of the foot-muscles pass chiefly to the byssus (*b*), and besides these two additional muscles (*p*, *p*) are developed. In *Pinna*, *Modiola* and *Dreissena* the byssal muscles are equal to the great adductors in size.

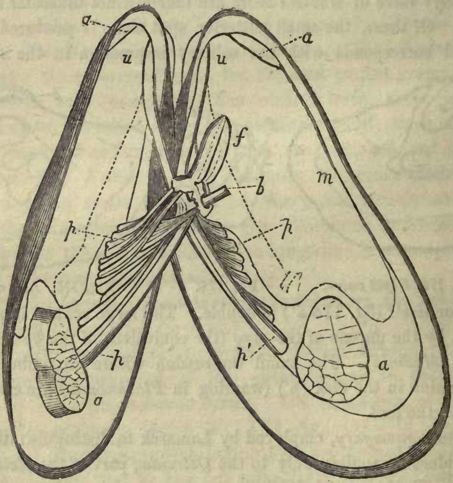

Fig. 177. Muscles of Modiola.*

In a few rare instances the muscles are fixed to prominent *apophyses.* The *falciform processes* of *Pholas* and *Teredo* (Pl. XXIII. fig. 19, 26) are developed for the attachment of the foot-muscle; the posterior muscular ridge of *Diceras* and *Cardilia* resembles a lateral tooth, and in the extinct genus *Radiolites* both adductors were attached to large tooth-like processes of the opercular valve; but, as a rule, the muscles deposit less shell than the mantle, and their impressions deepen with age.

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* Fig, 177. Muscular system of *Modiola modiolus*, L. from a drawing communicated by A. Hancock, Esq. *aa*, anterior, *a'a'* posterior adductors; *uu* and *p'p'*, pedal muscles; *pp*, byssal muscles; *f*, foot; *b*, byssus; *m*, pallial line.

The *pallial line* (fig. 177, *m*) is produced by the muscular fibres of the mantle-margin; it is broken up into irregular spots in the monomyary bivalves, and in *Saxicava* and *Panopæa Norvegica.*

The *siphonal impression,* or *pallial sinus* (fig. 14, p. 26,) only exists in those shells which have retractile siphons; its depth is an index to their length. The large combined siphons of *Mya* (fig. 170) are much longer than the shell; and those of some *Tellinidæ* three or four times its length, yet they are completely retractile. The small siphons of *Cyclas* and *Dreissena* cause no inflection of the pallial line. The *form* of the sinus is characteristic of genera and species.

In the *umbonal area* (within the pallial line) there are sometimes furrows produced by the viscera, which may be distinguished from the muscular markings by absence of polish and outline. (See *Lucina,* Pl. XIX. fig. 6.)

Fossil bivalves are of constant occurrence in all sedimentary rocks; they are somewhat rare in the oldest formations, but increase steadily in number and variety through the *secondary* and *tertiary* strata, and attain a maximum of development in existing seas.

Some families, like the *Cyprinidæ* and *Lucinidæ* are more abundant fossil than recent; whilst many genera, and one whole family (the *Hippuritidæ*), have become extinct. The determination of the affinities of fossil bivalves is often exceedingly difficult, owing to the conditions under which they occur. Sometimes they are found in pairs, filled up with hard stone; and frequently as casts, or moulds of the interior, giving no trace of the hinge, and very obscure indications of the muscular markings. Casts of single valves are more instructive, as they afford impressions of the hinge.*

Another difficulty arises from the frequent destruction of the nacreous or lamellar portion of the fossil bivalves, whilst the cellular layers remain. The *Aviculidæ* of the chalk have entirely lost their pearly interiors; the *Spondyli, Chamas,* and *Radiolites* are in the same condition, their inner layers are gone and no vacancy left, the whole interior being filled with chalk. As it is the inner layer alone which forms the hinge, and alone receives the impressions of the soft parts, the true characters of the shells could not be determined from such specimens. Our knowledge of the extinct *Radiolite* is derived from natural moulds of the interior, formed before the dissolution of the inner layer of shell, or from specimens in which this layer is replaced by spar.

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* These impressions may be conveniently moulded with *gutta-percha.* M. Agassiz published a set of plaster-casts of the interiors of the genera of recent shells, which may be seen in the Brit. Museum. [*Memoire sur les moules des Mollusques, vivans et fossiles, par L. Agassiz, Mem. Soc. Sc. Nat. Neuchatel, t.* 2.].

The necessities of geologists have compelled them to pay very minute attention to the markings in the interior of shells, to their microscopic texture, and every other available source of comparison and distinction. It must not, however, be expected that the entire structure and affinities of molluscous animals can be predicated from the examination of an internal mould or a morsel of shell, any more than that the form and habits of an extinct quadruped can be inferred from a solitary tooth or the fragment of a bone.*

The *systematic arrangement* of the bivalves now employed is essentially that of Lamarck, modified, however, by many recent observations. The families follow each other according to *relationship*, and not according to absolute rank; the *Veneridæ* are the highest organized, and from this culminating point the stream of affinities takes two courses, one towards the Myas, the other in the direction of the oysters; groups analogically related to the *Tunicaries* and *Brachiopoda*.

SECTION A. ASIPHONIDA.

a. Pallial line simple: Integro-pallialia.

Fam. 1. Ostreidæ.
2. Aviculidæ.
3. Mytilidæ.
4. Arcadæ.
5. Trigoniadæ.
6. Unionidæ.

SECTION B. SIPHONIDA.

7. Chamidæ.
8. Hippuritidæ.
9. Tridacnidæ.
10. Cardiadæ.
11. Lucinidæ.
12. Cycladidæ.
13. Cyprinidæ.

b. Pallial line sinuated: Sinu-pallialia.

14. Veneridæ.
15. Mactridæ.
16. Tellinidæ.
17. Solenidæ.
18. Myacidæ.
19. Anatinidæ.
20. Gastrochænidæ.
21. Pholadidæ.

The characters which have been most relied on for distinguishing these groups and the genera of bivalves are the following, stated nearly in the order of their value:—

1. Extent to which the mantle-lobes are united.
2. Number and position of muscular impressions.
3. Presence or absence of a *pallial sinus*.
4. Form of the foot.
5. Structure of the *branchiæ*.

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* *Etudes Critiques sur les Mollusques Fossiles, par L. Agassiz, Neuchatel,* 1840.

6. Microscopic structure of the shell. (*v.* p, 38.)
7. Position of the *ligament*, internal or external.
8. Dentition of the hinge.
9. Equality or inequality of the valves.
10. Regularity or irregularity of form.
11. Habit;—free, burrowing or fixed.
12. Medium of respiration, fresh or salt-water.

A few exceptions may be found, in which one or other of these characters does not possess its usual value.* Such instances serve to warn us against too implicit reliance on *single characters.* Groups, to be *natural,* must be based on the consideration of all these particulars—on "the totality of the animal organization." (Owen).

SECTION A. ASIPHONIDA.

Animal unprovided with respiratory siphons; mantle-lobes free, or united at only one point which divides the branchial from the exhalent chamber (*cloaca*); pallial impression simple.

Shell usually pearly or sub-nacreous inside; cellular externally; pallial line simple or obsolete.

FAMILY I. OSTREIDÆ.

Shell inequivalve, slightly inequilatural, free or adherent, resting on one valve; beaks central, straight; ligament internal; epidermis thin; adductor impression single, behind the centre; pallial line obscure; hinge usually edentulous.

Animal marine; mantle quite open; very slightly adherent to the edge of the shell; foot small and byssiferous, or obsolete; gills crescent-shaped, 2 on each side; adductor muscle composed of two elements, but representing only the *posterior* shell-muscle of other bivalves.

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* 1. *Cardita* and *Crassatella* (Fam. 13) have the mantle more open, whilst in *Iridina* (6), and especially in *Dreissena* (3) it is more closed than in the most nearly allied genera.

2. *Mulleria* (6) and *Tridacna* (9) are monomyary.

3. *Leda* (4) and *Adacna* (10) have a pallial sinus; *Anapa* (16) has none.

4. The form of the foot is usually characteristic of the families; but sometimes it is *adaptively* modified.

5. *Diplodonta* (11) has four gills.

6. Pearly structure is variable even in species of the same genus.

7. *Crassatella* (13) and *Semele* (16) have an internal ligament; in *Solenella* and *Isoarca* (4) it is external.

8. *Anodon* (16), *Adacna, Serripes* (10), and *Cryptodon* (11) are edentulous.

9. *Corbula* (18) and *Pandora* (19) are more inequivalve than their allies; *Chama arcinella* (7) is equivalve.

10. *Hinnites* (1), *Ætheria* (6), *Myochama* and *Chamostrea* (19) are irregular.

11. *Pecten* is free, byssiferous, or fixed: *Arca* free or byssiferous. This character varies with *age* and *locality* in the same species. It does not always depend on the form of the foot, as *Ætheria*, though fixed, ~~has a large foot~~, and *Lithodomus* and *Ungulina*—boring shells—have the foot like *Mytilus* and *Lucina.*

12. *Novaculina* is a river *Solen,* and *Scaphula* a fresh-water *Arca.*

Ostrea, L. Oyster.

Syn. Amphidonta and Pycnodonta, Fischer. Peloris, Poli.

Type, O. edulis, L. *Ex.* O. diluviana, Pl. XVI. fig. 1.

Shell irregular, attached by the left valve; upper valve flat or concave, often plain; lower convex, often plaited or foliaceous, and with a prominent beak; ligamental cavity triangular or elongated; hinge toothless; structure sub-nacreous, laminated, with prismatic cellular substance between the margins of the laminæ.

Animal with the mantle-margin double, finely fringed; gills nearly equal, united posteriorly to each other and the mantle-lobes, forming a complete branchial chamber; lips plain; palpi triangular, attached; sexes distinct.*

Distr. 60 sp. Tropical and temperate seas. Norway, Black Sea, &c.

Fossil, 200 sp. Carb. —. U. States, Europe, India.

The interior of recent oyster-shells has a slightly nacreous lustre; in fossil specimens an irregular cellular structure is often very apparent on decomposed or fractured surfaces. Fossil oysters which have grown upon *Ammonites*, *Trigoniæ*, &c. frequently take the form of those shells.

In the "cock's-comb" oysters both valves are plaited; *O. diluviana* sends out long root-like processes from its lower valve. The "Tree oyster" (*Dendrostrea*, Sw.) grows on the root of the mangrove. Oyster shells become very thick with age, especially in rough water; the fossil oyster of the Tagus (*O. longirostris*) attains a length of two feet. The greatest enemy of oyster-banks is a sponge (*Cliona*), which eats into the valves, both of dead and living shells; at first only small round holes, at irregular intervals, and often disposed in regular patterns, are visible; but ultimately the shell is completely mined and falls to pieces. Natural oyster-banks usually occur in water several fathoms deep; the oysters spawn in May and June, and the fry ("spats") are extensively collected and removed to artificial grounds, or tanks, where the water is very shallow; they are then called "natives," and do not attain their full growth in less than 5 or 7 years, whilst the "sea-oysters" are full-grown in 4 years. Native oysters do not breed freely, and many sometimes die in the spawning season; they are also liable to be killed by frost. The season is from August 4 to May 12. From 20 to 30,000 bushels of "natives" and 100,000 bushels of sea-oysters are annually sent to the London market. Many other species of oysters are eaten in India, China, Australia, &c. "Green oysters" are those which have fed on *con-*

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* The course of the alimentary canal in the common oyster is incorrectly represented by Poli, and copied in the Crochard ed. of Cuvier.

fervæ in the tanks. *Sub-genera. Gryphæa,* Lamarck. G. incurva, Sby (section) fig. 178. Free, or very slightly attached; left valve with a prominent, incurved umbo; right valve small, concave. *Fossil,* 30 sp. Lias — Chalk. Europe, India.

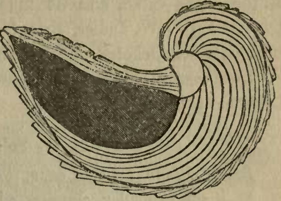

Fig. 178. Gryphæa.

Exogyra, Sby. E. conica, Pl. XVI. fig. 2. *Shell* chama-shaped, attached by the left valve; umbones sub-spiral, turned to the posterior side (i. e. reversed); right valve opercular. *Fossil,* 40 sp. L. Oolite — Chalk. U. States; Europe.

ANOMIA, L.

Etym. Anomios, unequal. *Ex.* A. Achæus, Pl. XVI. fig. 3.

Syn. Fenestrella, Bolten; Cepa, Humph. Aenigma, Koch.

Shell sub-orbicular, very variable, translucent, and slightly pearly within, attached by a plug passing through a hole or notch in the right valve: upper valve convex, smooth, lamellar or striated; interior with a sub-marginal cartilage-pit, and four muscular impressions, 3 sub-central, and one in front of the cartilage (see fig. 175, p. 249): lower valve concave, with a deep, rounded notch in front of the cartilage process; disk with a single (adductor) impression.

Animal with the mantle open, its margins with a short double fringe; lips membranous; palpi elongated, fixed, striated on both sides; gills 2 on each side, united posteriorly, the outer laminæ incomplete and free; foot small, cylindrical, subsidiary to a lamellar and more or less calcified byssal plug, attached to the upper valve by three muscles; adductor muscle behind the byssal muscles, small, composed of two elements; sexes distinct; ovary extending into the substance of the lower mantle-lobe

In *A. pernoides,* from California, there is an anterior (*pedal*) muscular impression in both valves.

"There is no relationship of *affinity* between *Anomia* and *Terebratula,* but only a resemblance through formal *analogy;* the parts which seem identical are not homologous." (Forbes).

The Anomiæ are found attached to oysters and other shells, and frequently acquire the form of the surfaces with which their growing margins are in contact. They are not edible.

Distr. 20 sp. N. America, Brit. Black Sea, India, Australia, W. America, Icy sea. Low-water — 100 fms.

Fossil, 30 sp. Oolite —, Chile, U. States, Europe.

Sub-genera. Placunomia (Cumingii) Broderip. *Syn.* Pododesmus, Phil. *P. macroschisma,* Pl. XVI. fig. 4. Upper valve with only two muscular impressions; the pedal scar radiately striated; the byssal plug is often fixed in the lower valve, and its muscle becomes (functionally) an adductor. *Distr.* 12 sp. W. Indies, Brit. (*P. patelliformis*), New Zealand, California, Behring's sea, Ochotsk. — 50 fms.

Limanomia (Grayana) Bouchard. Shell eared like *Lima*. *Fossil,* 4 sp. Devonian; Boulonnais, China ?

PLACUNA, Solander. Window-shell.

Etym. Plakous a thin cake. *Ex.* P. sella, Pl. XVI. fig. 5.

Shell sub-orbicular, compressed, translucent, free, resting on the right valve; hinge area narrow and obscure; cartilage supported by two diverging ridges in the right valve and corresponding grooves in the left; muscular impressions double, the larger element round and central, the smaller distinct and crescent shaped, in front of it.

The Placunæ are very closely allied to *Anomia;* and many intermediate forms may be traced. The shell of each consists entirely of sub-nacreous, plicated laminæ, peculiarly separable, and occasionally penetrated by minute tubuli. (*Carpenter.*) *P. sella,* called, from its shape, the "saddle-oyster," is remarkably striated. In *P. placenta,* Pl. XVI. fig. 6, the anterior cartilage ridge is only half so long as the other, which appears to be connected with the economy of the shell when young; in specimens 1 inch across, there is a pedal impression below the cartilage grooves of the upper valve, and a shallow sinus in the margin of the lower valve, indicating a slight byssal attachment at that age.

Distr. 4 sp. Scinde, N. Australia, China.

Sub-genera. Carolia, Cantraine 1835, (after Prince Charles Bonaparte.) *Syn.* Hemiplacuna, G. Sby. *Type,* C. placunoides, Pl. XVI. fig. 7. *Shell* like *Placuna;* hinge, when young, like Anomia, with a byssal plug passing through a small deep sinus in front of the cartilage process, which is closed in the adult. *Distr.* 3 sp. (Brit. Mus.) Tertiary, Egypt, America ?

Placunopsis, Morris and Lycett. P. Jurensis, Rœmer. Sub-orbicular, upper valve convex, radiately striated, or taking the form of the surface to which it adheres; lower valve flat; ligamental groove sub-marginal, transverse; muscular impression large, sub-central. *Fossil,* 4 sp. Lower Oolites, Europe.

PECTEN, O. F. Müller. Scallop.

Etym. Pecten, a comb. *Type,* P. maximus (Janira, Schum.)

Syn. Argus, Poli. Discites, Schl. Amusium, Muhlfeldt.

Shell sub-orbicular, regular, resting on the right valve, usually ornamented with radiating ribs; beaks approximate, eared; anterior ears most prominent; posterior side a little oblique; right valve most convex, with a notch below the front ear; hinge-margins straight, united by a narrow ligament; cartilage internal, in a central pit; adductor impression double, obscure; pedal impression only in the left valve, or obsolete (fig. 173).

Animal with the mantle quite open, its margins double, the inner pendent like a curtain (*m*) finely fringed; at its base a row of conspicuous round black eyes (*ocelli*) surrounded by tentacular filaments; gills (*br*) exceedingly delicate, crescent-shaped, quite disconnected posteriorly having separate excurrent canals; lips foliaceous; palpi truncated, plain outside, striated within; foot finger-like, grooved, byssiferous in the young.

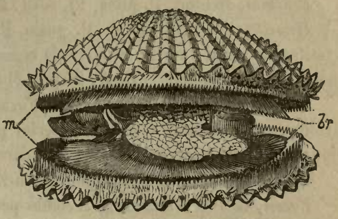

Fig. 179. Pecten varius.*

The Scallop (*P. maximus*) and "quin" (*P. opercularis*) are esteemed delicacies; the latter covers extensive banks, especially on the N. and W. of Ireland, in 15 to 25 fm. water. The scallop ranges from 3—40 fms.: its body is bright orange, or scarlet, the mantle fawn-colour, marbled with brown; the shell is used for "scalloping" oysters, formerly it was employed as a drinking cup, and celebrated as such in Ossian's "hall of shells." An allied species has received the name of "St. James's shell" (*P. Jacobæus*); it was worn by pilgrims to the Holy-land, and became the badge of several orders of knighthood.†

Most of the Pectens spin a byssus when young, and some, like *P. varius*, do so habitually; *P. niveus* moors itself to the fronds of the tangle (*Laminaria*.)

The Rev. D. Landsborough observed the fry of *P. opercularis*, when less than the size of a sixpence, swimming in a pool of sea-water left by the ebbing of the tide. "Their motion was rapid and zig-zag; they seemed, by the sudden opening and closing of their valves, to have the power of darting like an arrow through the water. One jerk carried them some yards, and then by another sudden jerk they were off in a moment on a different tack."

The shell of Pecten and the succeeding genera consists almost exclusively of membranous laminæ, coarsely or finely corrugated. It is composed of two very distinct layers, differing in colour (and also in texture and destructibility), but having essentially the same structure. Traces of cellularity are sometimes discoverable on the external surface; *P. nobilis* has a distinct prismatic-cellular layer externally. (*Carpenter*.)

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* The Pectens do not open so wide as here represented; their "curtains" remain in contact at one point on the posterior side, separating the branchial from the exhalent currents.

† When the monks of the ninth century converted the fisherman of Gennesarat into a Spanish warrior, they assigned him the scallop-shell for his "cognizance."—*Moule's Heraldry of Fish.*

Sub-genera, Neithea, Drouet. P. quinque-costatus and other fossil sp. with concavo-convex valves and distinct hinge-teeth; the inner layers of these shells are wanting in all specimens from the English chalk.

Pallium, Schum. P. plica, Pl. XVI. fig. 8. Hinge obscurely toothed.

Hinnites (Cortesii) Defr. P. pùsio, Pl. XVI. fig. 10. Shell regular and byssiferous when young; afterwards cementing its lower valve and becoming more or less irregular. *Distr.* 2 sp. *Fossil,* Trias? Miocene —, Europe.

Hemipecten, A. Adams. H. Forbesianus, Pl. XVI. fig. 9. Shell hyaline, posterior ears obsolete, anterior prominent; right valve flat, byssal sinus deep; structure permeated by microscopic tubuli, as in *Lima.*

Distr. 120 sp. World-wide; Nova-Zembla — C. Horn; — 200 fms.

Fossil, 450 sp. (including Aviculo-pecten). Carb. —. World-wide.

LIMA, Bruguiere.

Etym. Lima, a file. *Ex.* L. squamosa, Pl. XVI. fig. 11. (Ostrea lima, L.)

Syn. Plagiostoma (Llhwyd) Sby. P. cardiiforme, Pl. XVI. fig. 12.

Shell equivalve, compressed, obliquely oval; anterior side straight, gaping, posterior rounded, usually close; umbones apart, eared; valves smooth, punctate-striate, or radiately ribbed and imbricated; hinge area triangular, cartilage pit central; adductor impression lateral, large, double; pedal scars 2, small.

Animal, mantle-magins separate, inner pendent, fringed with long tentacular filaments, ocelli inconspicuous; foot finger-like, grooved; lips with tentacular filaments, palpi small, striated inside; gills equal on each side, distinct.

The shell is always white; its outer layer consists of coarsely-plicated membranous lamellæ; the inner layer is perforated by minute tubuli, forming a complete network. (*Carpenter.*)

The Limas are either free or spin a byssus; some make an artificial burrow when adult, by spinning together sand or coral-fragments and shells, but the habit is not constant. (*Forbes.*) The burrows of *L. hians* are several times longer than the shell, and closed at each end. (*Charlesworth.*) " This species is pale or deep crimson, with an orange mantle; when taken out of its nest it is one of the most beautiful marine animals to look upon, it swims with great vigour, like the scallop, by opening and closing its valves, so that it is impelled onwards or upwards in a succession of jumps. The filaments of the fringe are easily broken off, and seem to live many hours after they are detached, twisting themselves like worms." (*Landsborough.*) *L. spinosa* has conspicuous ocelli, and short filaments.

Sub-genera, Limatula, S. Wood. L. sub-auriculata, Pl. XVI. fig. 13. Valves equilateral; 8 sp. Greenland — Brit. *Fossil,* Miocene —. Europe.

Limæa, Bronn. L. strigilata, Pl. XVI. fig. 14.* Hinge minutely toothed. *Fossil*, 4 sp. Lias — Pliocene. The recent *Limæa ? Sarsii* (Lovén) Norway (= L. crassa of the Ægean ?) has the mantle-border plain. Some of the larger recent sp. have obscure lateral teeth.

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* After Bronn; the figure in Brocchi does not show the teeth.

Distr. 20 sp. Norway, Brit. W. Indies, Canaries, India, Australia; 1—150 fms. The largest living sp. (*L. excavata*, Chemn.) is found on the coast of Norway.

Fossil, 200 sp. Carb. ? Trias —. U. States, Europe, India. The so-called *Plagiostoma spinosum* is a Spondylus.

SPONDYLUS, (Pliny) L. Thorny-oyster.

Type, S. gædaropus, L. *Ex.* S. princeps, Pl. XVI. fig. 15.

Syn. Dianchora, Sby. Podopsis, Lam. Pachytes, Defr.

Shell irregular, attached by the right valve, radiately ribbed, spiny or foliaceous; umbones remote, eared; lower valve with a triangular hinge-area, cartilage in a central groove, nearly or quite covered; hinge of 2 curved interlocking teeth in each valve; adductor impression double.

Animal, with the mantle open and gills separate, as in *Pecten;* lips foliaceous, palpi short; foot small, cylindrical, truncated.

In aged specimens the circular portion of the muscular scar exhibits dendritic vascular markings. The lower valve is always most spiny and least coloured; in some sp. (like *S. imperialis*) the shell is scarcely, if at all, attached by its beak or spines. The inner shell-layer is very distinct from the outer, and always wanting in fossil specimens from calcarious rocks, then called *Dianchoræ.* Specimens from the Miocene of St. Domingo, which have lost this layer, contain a loose mould of the original interior. Water-cavities are common in the inner layer, the border of the mantle having deposited shell more rapidly than the umbonal portion. (*Owen*, Mag. Nat. Hist. 1838, p. 409.)

Distr. 30 sp. W. Indies, Canaries, Medit. India, Torres Straits, Pacific, W. America:—105 fms.

Fossil, 45 sp. Inf. Oolite ? Neocomian —. Europe, U. States, India.

Sub-genus, Pedum, Brug. P. spondyloides, Pl. XVI. fig. 16. *Shell* thin, smooth, compressed, attached by a byssus passing through a deep notch in the right valve. Inhabits coral-reefs, where it is found half-imbeded; Red Sea, Indian Ocean, Mauritius, Chinese Seas.

PLICATULA, Lamarck.

Etym. Plicatus, plaited.

Type, P. cristata, Pl. XVI. fig. 17.

Shell irregular, attached by the umbo of the right valve; valves smooth or plaited; hinge-area obscure; cartilage quite internal; hinge-teeth, 2 in each valve; adductor scar simple.

Distr. 6 sp. W. Indies, India, Philippines, Australia, W. America.

Fossil, 40 sp. Trias —. U. S. Europe, Algeria, India.

P. Mantelli (Lea) Alabama, has the valves eared.

FAMILY II. AVICULIDÆ. Wing-shells.

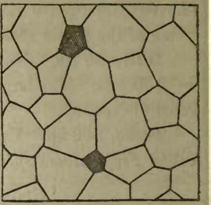

Fig. 180, Pinna.*

Shell inequivalve, very oblique, resting on the smaller (right) valve, and attached by a byssus; epidermis indistinct: outer layer prismatic-cellular, (fig. 180) interior nacreous; posterior muscular impression large, sub-central, anterior small, within the umbo; pallial line, irregularly dotted; hinge-line straight, elongated; umbones anterior, eared, the posterior ear wing-like; cartilage contained in one or several grooves; hinge edentulous, or obscurely toothed.

Animal with the mantle-lobes free, their margins fringed; foot small, spinning a byssus; gills 2 on each side, crescent-shaped, entirely free (*Desh.*) or united to each other posteriorly, and to the mantle (as in the Oyster, and not as in *Pecten*).

The wing-shells, or pearl-oysters, are natives of tropical and temperate seas; there are no living species in northern latitudes, where fossil forms are very numerous.

AVICULA (Klein) Bruguiere.

Etym. Avicula, a little bird. *Type,* A. hirundo, Pl. XVI. fig. 18.

Shell obliquely oval, very inequivalve; right valve with a byssal sinus beneath the anterior ear; cartilage pit single, oblique; hinge with 1 or 2 small cardinal teeth, and an elongated posterior tooth, often obsolete; posterior muscular impression (adductor and pedal) large, sub-central; anterior (pedal scar) small, umbonal.

Animal (of meleagrina) with mantle-lobes united at one point by the gills, their margins fringed and furnished with a pendent curtain; curtains fringed in the branchial region, plain behind; foot finger-like, grooved; byssus often solid, cylindrical, with an expanded termination; pedal muscles 4, posterior large in front of the adductor; adductor composed of 2 elements; retractors of the mantle forming a series of dots, and a large spot near the adductor; lips simple: palpi truncated; gills equal, crescentic, united behind the foot. (Brit. M.)

Distr. 25 sp. Mexico, S. Brit. Medit. India, Pacific:—20 fms.

Fossil, 300 sp. L. Silurian —. World-wide.

Sub-genera, Meleagrina, Lam. M. margaritifera, Pl. XVI. fig. 19. The "pearl-oysters" are less oblique than the other *aviculæ,* and their valves are flatter and nearly equal; the posterior pedal impression is blended with that of the great adductor. They are found at Madagascar, Ceylon, Swan

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* The cellular structure may be seen with a hand-lens, in the thin margin of the shell, by holding it up to the light; or on the edges of broken fragments.

R. Panama, &c. Manilla is the chief port to which they are taken. There are three principal kinds, which are worth from £2 to £4 per cwt.: 1. the silver-lipped, from the Society Ids. of which about 20 tons are annually imported to Liverpool; 2. the black-lipped, from Manilla, of which 30 tons were imported in 1851; 3. a smaller sort from Panama, 200 tons of which are annually imported; in 1851 a single vessel brought 340 tons. (T. C. Archer.) These shells afford the "mother-o'-pearl" used for ornamental purposes; and the "oriental" pearls of commerce (p. 38). Mr. Hope's pearl, said to be the largest known, measures 2 inches long, 4 round, and weighs 1800 grains.* Pearl-oysters are found in about 12 fathom water; the fisheries of the Persian Gulf and Ceylon have been celebrated from the time of Pliny.

Malleus, Lam. M. vulgaris, Pl. XVI. fig. 20. The "hammer-oyster" is remarkable for its form, which becomes extremely elongated with age; both ears are long, and the umbones central. When young it is like an ordinary Avicula, with a deep byssal notch in the right valve. 6 sp. China, Australia.

Vulsella, Lam. V. lingulata, Pl. XVI. fig. 21. *Syn.* Reniella, Sw. Shell oblong, striated, sub-equivalve; umbones straight, earless. Often found imbedded in living sponges. *Distr.* 3 sp. Red Sea, India, Australia, Tasmania. *Fossil,* 4 sp. U. Chalk —. Brit. France.

Pteroperna, Lycett, 1852. P. costatula, Desl. *Shell* with a long posterior wing; hinge-line bordered by a groove; anterior teeth numerous, minute; posterior 1 or 2, long, nearly parallel with the hinge-margin. *Fossil,* 3 sp. Bath oolite; Brit. France.

? ~~*Aucella*~~ (Pallasii) ~~Keyserling~~, 1846. (*Monotis,* Münster, not Bronn.) Very inequivalve; left umbo prominent, earless; right valve small and flat, with a deep sinus beneath the small anterior ear. *Fossil,* Permian — Gault. Europe. "In *A. cygnipes* we find no trace of prismatic cellular structure or nacre, but the coarsely corrugated and somewhat tubular structure of the Pectens." (*Carpenter.*)

Ambonychia (bellistriata) Hall, 1847. Nearly equivalve, gibbose, oblique, obtusely winged. *A. vetusta* (Inoceramus, Sby.) is concentrically furrowed; the right valve has a small anterior ear (usually concealed) separated by a deep and narrow sinus. *Fossil,* 12 sp. L. Silurian — Carb. U. S. Europe.

? *Cardiola* (interrupta) Broderip, 1844. Equivalve, gibbose, obliquely oval, radiately ribbed; beaks prominent; hinge-area short and flat. *Fossil,* 17 sp. U. Silurian — Dev. U. S. Europe.

? *Eurydesma* (cordata) Morris; Devonian? N. S. Wales. *Shell* equivalve, sub-orbicular, ventricose, very thick near the beaks; ligamental area long, wide, sub-internal; byssal groove close to the umbo; right valve with a large, blunt hinge-tooth; adductor impression single, placed anteriorly; pallial line dotted.

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* Sections of oriental pearls exhibit very fine concentric laminæ surrounding a grain of sand, or some such extraneous matter; the nacreous lustre has been attributed to the diffraction of light from the out-cropping edges of the laminæ, but Dr. Carpenter has shown that it may result from the minute plication of a *single* lamina. (See fig. 23, p. 38.)

Pterinea (lævis) Goldf. 1832. *Shell* thick, rather inequivalve, very oblique and broadly winged; beaks anterior; sinus shallow; hinge-area long, straight, narrow, striated lengthwise; anterior teeth few, radiating; posterior teeth laminar, elongated; anterior (pedal) scar deep, posterior (adductor) impression large, very eccentric. *Fossil,* 25 sp. L. Sil. — Carb. U. S. Europe, Australia. Pteronites (angustatus) M'Coy, 1844, is thinner and has the teeth, &c. less developed.

Monotis, Bronn, 1830. M. salinaria, Schl. *Trias,* Hallein. Obliquely oval, compressed, radiated; anterior side short, rounded; posterior slightly eared.

Syn. ? *Halobia* (salinarum) Br. 1830. *Trias,* Hallstadt. Semi-oval, radiated, compressed, with a shallow sinus in front; hinge-line long and straight.

POSIDONOMYA, Bronn.

Syn. Posidonia, Br. 1828. (not König). *Poseidôn,* Neptune.

Type, P. Becheri, Pl. XVI. fig. 22.

Shell thin, equivalve, compressed, earless, concentrically furrowed; hinge-line short and straight, edentulous.

Fossil, 50 sp. L. Silurian — Trias. U. S. Europe.

? AVICULO-PECTEN, M'Coy, 1852

Type, Pecten granosus, Sby. Min. Con. t. 574.

Shell inequivalve, sub-orbicular, eared; hinge-areas flat, with several long, narrow cartilage furrows, slightly oblique on each side of the umbones; right valve with a deep and narrow byssal sinus beneath the anterior ear; adductor impression large, simple, sub-central; pedal scar small and deep, beneath the umbo.

Fossil (see Pecten). L. Silurian — Carb. Spitzbergen — Australia.

GERVILLIA, Defrance.

Etym. Dedicated to M. Gerville, a French naturalist.

Ex. G. anceps, Pl. XVII. fig. 1.

Shell like Avicula; elongated: anterior ear small, posterior wing-like: area long and flat, cartilage pits several, wide apart; hinge-teeth obscure, diverging posteriorly.

Fossil, 30 sp. Carb. — Chalk. Europe.

Sub-genus ? *Bakewellia,* King. B. ceratophaga, Schl. *Fossil,* 5 sp. Permian, Brit. Germany, Russia. *Shell* small, inequivalve, cartilage pits 2—5; hinge with anterior and posterior teeth; anterior muscular impression and pallial line distinct.

PERNA, Bruguiere.

Etym. Perna, a shell-fish (resembling a *gammon*) Pliny.

Syn. Melina, Retz. Isognomon, Klein. Pedalion, Solander.

Type, P. ephippium, L. Pl. XVII. fig. 2.

Shell nearly equivalve, compressed, sub-quadrate; area wide, cartilage pits numerous, elongated, close-set; right valve with a byssal sinus; muscular impression double.

The Pernas vary in form like the *Aviculæ*; some are very oblique, some very inequivalve, and many fossil sp. have the posterior side produced and wing-like. In some Tertiary Pernas the pearly layer is an inch thick.

Distr. 16 sp. Tropical seas; W. Indies — India — W. America.

Fossil, 30 sp. Trias —. U. States, Chile, Europe.

Sub-genera, *Crenatula*, Lamk. C. viridis, Pl. XVI. fig. 24. *Shell* thin, oblong, compressed; byssal sinus obsolete; cartilage pits shallow, crescent-shaped. *Distr.* 5 sp. N. Africa, Red Sea — China; in sponges.

Hypotrema, D'Orb. 1853. H. rupellensis (= ? Pulvinites Adansonii, Defr. 1826); Coral-rag, Rochelle. *Shell* oblong, inequivalve; right valve flat or concave, with a round byssal foramen near the hinge; left valve convex, with a muscular impression near the umbo; hinge-margin broad, curved, with about 12 close-set transverse cartilage grooves.

INOCERAMUS, Sowerby (1814).

Etym. Is (inos) fibre, *Keramos* shell.

Ex. I. sulcatus, Pl. XVII. fig. 3. *Syn.* Catillus, Brongn.

Shell inequivalve, ventricose, radiately or concentrically furrowed, umbones prominent; hinge-line straight, elongated; cartilage pits transverse, numerous, close-set.

This genus differs from *Perna* chiefly in form. *I. involutus* has the left valve spiral, the right opercular. *I. Cuvieri* attains the length of a yard. Large flat fragments are common both in the chalk and flints, and are often perforated by the *Cliona.* Hemispherical pearls have been found developed from their inner surface, and spherical pearls of the same prismatic-cellular structure occur detached, in the chalk. (*Wetherell.*) The *Inocerami* of the gault are nacreous.

Fossil, 40 sp. Lias — Chalk. S. America, U.S. Europe, Algeria, Thibet.

PINNA, L.

Etym. Pinna, a fin or wing. *Type*, P. squamosa, Pl. XVI. fig. 23.

Shell equivalve, wedge-shaped; umbones quite anterior; posterior side truncated and gaping; ligamental groove linear, elongated; hinge edentulous; anterior adductor scar apical, posterior sub-central, large, ill-defined; pedal scar in front of posterior adductor.

Animal with the mantle margin doubly fringed; foot elongated, grooved, spinning a powerful byssus, attached by large triple muscles to the centre of each valve; adductors both large; palpi elongated; gills long.

Distr. 30 sp. U. States, S. Brit. Medit. Australia, Pacific, Panama.

Fossil, 50 sp. Devonian —. U. S. Europe, S. India.

The shell of the *Pinna* attains a length of two feet; when young it is thin, brittle, and translucent, consisting almost entirely of prismatic cell-layers; the pearly lining is thin, divided, and extends less than halfway from the beak. Some fossil Pinnas crumble under the touch into their component fibres. The living sp. range from extreme low-water to 60 fms; they are moored vertically, and often nearly buried in sand, with knife-like edges erect. The byssus has sometimes been mixed with silk, spun, and knitted into gloves, &c. (Brit. Mus.) A little crab which nestles in the mantle and gills of the Pinna, was anciently believed to have formed an alliance with the blind shellfish, and received the name of Pinna-guardian (*Pinnoteres*) from Aristotle; similar species infest the Mussels and *Anomiæ* of the British coast.

Sub-genus, Trichites, (Plott) Lycett. T. Plottii, Llhwyd. ("Pinnigene," Saussure.) *Shell* thick, inequivalve, somewhat irregular, margins undulated. *Fossil,* 5 sp. Oolitic strata of England and France. Fragments an inch or more in thickness are common in the Cotteswolde-hills; full-grown individuals are supposed to have measured a yard across.

FAMILY III. MYTILIDÆ. Mussels.

Shell equivalve, oval or elongated, closed, umbones anterior, epidermis thick and dark, often filamentose; ligament internal, sub-marginal, very long; hinge edentulous; outer shell layer obscurely prismatic-cellular;* inner more or less nacreous; pallial line simple; anterior muscular impression small and narrow, posterior large, obscure.

Animal marine or fluviatile, attached by a byssus; mantle-lobes united between the siphonal openings; gills two on each side, elongated, and united behind to each other and to the mantle, dorsal margins of the outer and innermost laminæ free; foot cylindrical, grooved.

The shells of this family exhibit a propensity for concealment, frequently spinning a nest of sand and shell-fragments, burrowing in soft substances, or secreting themselves in the burrows of other shells.

MYTILUS, L. Sea-mussel.

Ex. M. smaragdinus, Pl. XVII. fig. 4.

Shell wedge-shaped, rounded behind; umbones terminal, pointed; hinge-teeth minute or obsolete; pedal muscular impressions two in each valve, small, simple, close to the adductors.

Animal with the mantle-margins plain in the anal region, and projecting slightly; branchial margins fringed; byssus strong and coarse; gills nearly equal; palpi long and pointed, free.

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* A thin layer of minute cells may frequently be detected immediately under the epidermis. (*Carpenter.*)

The common edible mussel frequents mud-banks which are uncovered at low-water; the fry abound in water a few fathoms deep; they are full-grown in a single year. From some unknown cause they are, at times, extremely deleterious. The consumption of mussels in Edinburgh and Leith is estimated at 400 bushels (=400,000 mussels) annually; enormous quantities are also used for bait, especially in the deep sea fishery, for which purpose 30 or 40 millions are collected yearly in the Frith of Forth alone. (*Dr. Knapp.*) Mussels produce small and inferior pearls. At Port Stanley, Falkland Ids. Mr. Macgillivray noticed beds of mussels which were chiefly dead, being frozen at low-water. *M. bilocularis* (Septifer, Recluz) has an umbonal shelf for the support of the anterior adductor, like *Dreissena;* it is found at Mauritius and Australia. *M. exustus* (Brachydontes, Sw.) has the hinge-margin denticulated continuously.

Distr. 50 sp. World-wide. Ochotsk, Behring's Sea, Russian Ice-meer; Black Sea, C. Horn, Cape, New Zealand.

Fossil, 80 sp. Permian —. U. S. Europe, S. India.

? MYALINA, Koninck, 1842.

Types, M. Goldfussiana, Kon. Carb. M. acuminata, Sby. Permian.

Shell equivalve, mytili-form; beaks nearly terminal, septiferous internally; hinge-margin thickened, flat, with several longitudinal cartilage-grooves; muscular impressions 2; pallial line simple.

Fossil 6 sp. Carb. — Permian. Europe. The ligamental area resembles that of the recent Arca obliquata, Chemn. India.

MODIOLA, Lam. Horse-mussel.

Etym. *Modiolus,* a small measure, or drinking-vessel.

Ex. M. tulipa, Pl. XVII. fig. 5. M. modiolus, p. 250, fig. 177.

Shell oblong, inflated in front: umbones anterior, obtuse: hinge toothless; pedal impressions 3 in each valve, the central elongated; epidermis often produced into long beard-like fringes.

Animal with the mantle-margin simple, protruding in the branchial region; byssus ample, fine; palpi triangular, pointed.

The *Modiolæ* are distinguished from the Mussels by their habit of burrowing, or spinning a nest. Low-water—100 fms.

Distr. 50 sp. chiefly tropical; *M. modiolus,* Arctic seas — Brit.

Fossil, 130 sp. Silurian ? Lias —. U. S. Europe, Thibet, S. India.

Sub-genera. *Lithodomus,* Cuv. M. lithophaga, Pl. XVII. fig. 7. *Shell* cylindrical, inflated in front, wedge-shaped behind; epidermis thick and dark; interior nacreous.* *Distr.* 12 sp. W. Indies — New Zealand. *Fossil,*

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* The outer shell-layer has a tubular structure; the tubes are excessively minute, seldom branching, oblique and parallel. (*Carpenter.*)

16 sp. Bath oolite —. Europe, U. S. The "date-shell" bores into corals, shells, and the hardest limestone rocks (fig. 25, p. 42); its burrows are shaped like the shell, and do not admit of free rotatory motion. The animal, which is eaten in the Medit. is like a common mussel; in *L. patagonicus* the siphons are produced. Like other burrowing shellfish, they are luminous. Perforations of *Lithodomi* in limestone cliffs, and in the columns of the Temple of Serâpis at Puteoli, have afforded conclusive evidence of changes in the level of sea-coasts in modern times. (*Lyell's Principles of Geology.*)

Crenella, Brown. C. discors, Pl. XVII. fig. 8. (Lanistes, Sw. Modiolaria, Beck.) *Shell* short and tumid, partly smooth, and partly ornamented with radiating striæ; hinge-margin crenulated behind the ligament; interior brilliantly nacreous. *Animal* with the anal tube and branchial margins prominent. *Distr.* Temperate and arctic seas; Nova Zembla, Ochotsk, Brit. New Zealand. Low-water — 40 fms. Spinning a nest, or hiding amongst the roots of sea-weed and corallines. *M. marmorata*, Forbes, burrows in the test of *Ascidia*. *Fossil*, U. Green-sand —. Europe.

Modiolarca (trapezina) Gray; Falkland Ids. — Kerguelen, attached to floating sea-weed; mantle-lobes united, pedal opening small, foot with an expanded sole, front adductor round. *M.* ? *pelagica*, Pl. XVII. fig. 6. is found burrowing in floating blubber, off the Cape. (*Forbes.*)

? *Mytilimeria* (Nuttallii) Conrad. *Shell* irregularly oval, thin, edentulous, gaping posteriorly; umbones sub-spiral; ligament short, semi-internal. *Distr.* California; animal gregarious, forming a nest.

Modiolopsis (mytiloides) Hall, 1847 (= Cypricardites, part, Conrad. Lyonsia, part, D'Orb.) *Shell* like modiola, thin and smooth, front end somewhat lobed; anterior adductor scar large and oval. *Fossil*, Silurian, U. S. Europe.

? *Orthonotus* (pholadis) Conrad. L. Silurian, New York. *Shell* elongated, margins parallel, umbones anterior, back plaited.*

DREISSENA, Van Beneden.

Etym. Dedicated to Dreyssen, a Belgian physician.

Syn. Mytilomya, Cantr. Congeria, Partsch. Tichogonia, Rossm.

Type, D. polymorpha, Pl. XVII. fig. 9. (Mytilus Volgæ, Chemn.)

Shell like *Mytilus*, without its pearly lining; inner layer composed of large prismatic cells; umbones terminal; valves obtusely keeled; right valve with a slight byssal sinus; anterior adductor supported on a shelf within the beak; pedal impression single, posterior.

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* Hall and Salter employ the name *Orthonotus* for such shells as *Solen constrictus*, Sandb. Devonian, Germany; *Sanguinolites anguliferus*, M'Coy, U. Silurian, Kendal; and *Solenopsis minor*, M'Coy, Carb. limestone, Ireland. M. D'Orbigny has mistaken the plaits for teeth, and placed the genus with *Nucula*. The recent *M. plicata*, Lam. from Nicobar Ids. has the same long straight back and plaited dorsal region.

Animal with the mantle closed; byssal orifice small; anal siphon very small, conical, plain, branchial prominent, fringed inside; palpi small, triangular; foot-muscles short and thick, close in front of the posterior adductor.

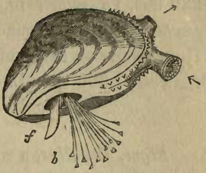

Fig. 181. Dreissena.

D. polymorpha is a native of the Aralo-Caspian rivers; in 1824 it was observed by Mr. J. Sowerby in the Surrey docks, to which it appears to have been brought with foreign timber, in the holds of vessels. It has since spread into the canals and docks of many parts of the country, and has been noticed in the iron water-pipes of London, incrusted with a ferruginous deposit. (*Cunnington.*)

Fossil. 10 sp. Eocene —. Brit. Germany.

FAMILY IV. ARCADÆ.

Shell regular, equivalve, with strong epidermis; hinge with a long row of similar, comb-like teeth; pallial line distinct; muscular impressions subequal. Structure corrugated, with vertical tubuli in rays between the ribs or striæ. (*Carpenter.*)

Animal with the mantle open; foot large, bent, and deeply grooved; gills very oblique, united posteriorly to a membranous septum.

ARCA, L.

Etym. Arca, a chest. *Type,* A. Noæ, Pl. XVII. fig. 12.

Ex. A. granosa, Pl. XVII. fig. 10. A. pexata, fig. 11. A. zebra, fig. 13.

Shell equivalve or nearly so, thick, sub-quadrate, ventricose, strongly ribbed or cancellated; margins smooth or dentated, close or sinuated ventrally; hinge straight, teeth very numerous, transverse; umbones anterior, separated by a flat, lozenge-shaped ligamental area, with numerous cartilage-grooves; pallial line simple; posterior adductor impression double; pedal scars 2, the posterior elongated.

Animal with a long pointed foot, heeled and deeply grooved; mantle furnished with ocelli; palpi 0; gills long, narrow, less striated externally, continuous with the lips: hearts two, each with an auricle.

The name *Bysso-arca* was chosen unfortunately, by Swainson, for the *typical* species of the genus, in which the byssal orifice is sometimes very large (Pl. XVII. fig. 13). The byssus is a horny cone, composed of numerous thin plates, occasionally becoming solid and calcarious; it can be cast off and re-formed with great rapidity. (*Forbes.*) The Arcas with close valves have the left valve a little larger than the right, and more ornate.

The Bysso-arks secrete themselves under stones at low-water, in crevices of rocks, and the empty burrows of boring mollusks; they are often much worn and distorted.

Distr. 130 sp. World-wide, most abundant in warm sea; low water —

230 fms. (*A. imbricata*, Poli). Prince-Regent Inlet (*A. glacialis*) *A. scaphula, Benson,* is found in the Ganges and its branches, from Calcutta to Humeerpoor on the Jumna, 1000 miles from the sea.

Fossil, 200 sp. L. Silurian —. U. S. Europe; S. India.

CUCULLÆA, Lamarck.

Etym. Cucullus, a cowl. *Type,* C. concamerata, Pl. XVII. fig. 14.

Shell sub-quadrate, ventricose; valves close, striated; hinge-teeth few and oblique, parallel with the hinge-line at each end; posterior muscular impression bounded by an elevated ridge.

Distr. 1 sp. Mauritius, Nicobar, China.

Fossil, 100 sp. L. Silurian —. N. America, Patagonia, Europe.

Sub-genus, Macrodon, Lycett. M. Hirsonensis, Pl. XVII. fig. 15. *Shell* with a few oblique anterior teeth and one or more long laminar posterior teeth. The Ark-shells of the Palæozoic and secondary strata have their anterior teeth more or less oblique, like *Arca,* the posterior teeth parallel with the hinge-line like *Cucullæa;* their valves are close or gaping below; their umbones frequently sub-spiral; and the hinge-area is often very narrow, and in some species only the posterior moiety is visible.

PECTUNCULUS, Lam.

Type, P. pectiniformis, Pl. XVII. fig. 16. (Arca pectunculus, L.)

Shell orbicular, nearly equilateral, smooth or radiately striated; umbones central, divided by a striated ligamental area; hinge with a semicircular row of transverse teeth; adductors sub-equal; pallial line simple; margins crenated inside.

Animal with a large crescent-shaped foot, margins of the sole undulated; mantle open, margins simple, with minute ocelli; gills equal, lips continuous with the gills.

Distr. 50 sp. W. Indies, Brit. India, N. Zealand, W. America: ranging from 8 to 60, rarely 120 fathoms.

Fossil, 70 sp. Neocomian —. U. S. Europe: S. India.

The teeth of *Pectunculus* and *Arca* increase in number with age, by additions to each end of the hinge-line, but sometimes the central teeth are obliterated by encroachments of the ligament.

LIMOPSIS, Sassi, 1827.

Type, L. aurita, Pl. XVII. fig. 17. *Syn.* Trigonocœlia, Nyst.

Shell orbicular, convex, slightly oblique; ligamental area with a triangular cartilage-pit in the centre; hinge with 2 equal, curved series of transverse teeth.

Distr. 1 sp. Red Sea (Nyst.)

Fossil, 17 sp. Bath-oolite —. U. States; Europe.

NUCULA, Lam.

Etym. Diminutive of *nux,* a nut. *Ex.* N. Cobboldiæ, Pl. XVII. fig. 18.

Shell trigonal, with the umbones turned towards the short *posterior* side; smooth or sculptured, epidermis olive, interior pearly, margins crenulated; hinge with prominent internal cartilage-pit, and a series of sharp teeth on each side; pallial line simple.

Animal with the mantle open, its margins plain; foot large, deeply fissured in front, forming when expanded a disk with serrated margins; mouth and lips minute, palpi very large, rounded, strongly plaited inside and furnished with a long convoluted appendage; gills small, plume-like, united behind the foot to the branchial septum.

The Nucula uses its foot for burrowing, and Prof. Forbes has seen it creep up the side of a glass of sea-water. The labial appendages protrude from the shell at the same time with the foot. *N. mirabilis,* Adams, from Japan, is sculptured like the extinct *N. Cobboldiæ.*

Distr. 70 sp. U. S. Norway, Cape, Japan, Sitka, Chile. On coarse bottoms, from 5—100 fms.

Fossil, 100 sp. L. Silurian ? —. Trias —. America, Europe, India.

Sub-genera. Nuculina, D'Orb.* 1847. N. miliaris, Pl. XVII. fig. 19. *Shell* minute; teeth few, in one series, with a posterior lateral tooth. *Eocene,* France. Nucinella (ovalis) Searles-Wood, 1850 (=Pleurodon, Wood, 1840) a minute shell from the Coralline crag of Suffolk, is described as having an external ligament.

? *Stalagmium* (margaritaceum) Conrad, 1833=Myoparo costatus, Lea. *Eocene,* Alabama. ? *S. Nystii,* Galeotti (Nucunella, D'Orb. *Eocene,* Belgium. *Shell* like *Limopsis;* ligamental area narrow, wholly posterior.

ISOARCA, Münster, 1842.

Type, I. subspirata, M. Oxford Clay; France, Germany.

Shell ventricose; beaks large, anterior, often sub-spiral; ligament entirely external; hinge-line curved, with two series of transverse teeth, smallest in the centre; pallial line simple.

I. Logani (Ctenodonta) Salter, L. Silurian, Canada. is 3 inches-long and has the ligament preserved.

Fossil, 14 sp. L. Silurian — Chalk. N. America; Europe.

Sub-genus. Cucullella, M'Coy. C. antiqua, Sby. U. Silurian, Herefordshire. *Shell* elliptical, with a strong rib behind the anterior adductor impression.

LEDA, Schumacher.

Etym. Leda, in Greek myth. mother of Castor and Pollux.

Syn. Lembulus (Leach) Risso. *Ex.* L. caudata, Pl. XVII. fig. 20.

Shell resembling *Nucula;* oblong, rounded in front, produced and pointed behind; margins even; pallial line with a small sinus; umbonal area with a linear impression joining the anterior adductor.

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* *N. donaciformis,* Parreyss, from the White Nile, is a crustacean! (*Estheria*).

Animal furnished with two partially-united, slender, unequal, siphonal tubes (*Forbes*); gills narrow, plume-like, deeply laminated, attached throughout; mantle-margin with small ventral lobes forming by their apposition a third siphon.

Distr. 30 sp. Northern and Arctic Seas, 10—180 fms. Siberia, Melville Id. Mass. Brit. Medit. Cape, Japan, Australia.

Fossil, 110 sp. U. S. Europe; S. India.

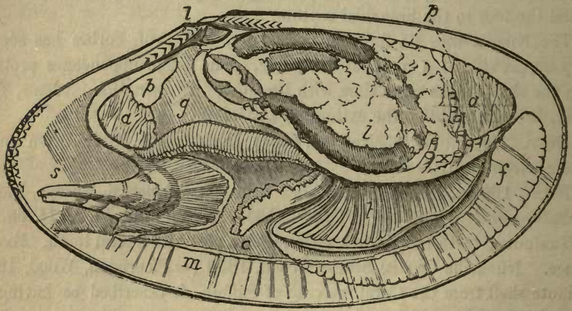

Fig. 182. Yoldia n. sp. $\frac{2}{1}$. Antarctic Expedition.

(From a drawing by Albany Hancock, Esq.) The internal organs are represented as seen, through the mantle, on the removal of the right valve.

a, *a*, adductors; *p*, *p*, pedal muscles; *l*, ligament; *g*, gills; *s*, siphons (much contracted); *t*. *c*, labial palpi and appendages; *i*, intestine; *f*, foot; *x*, *x*, lateral muscles of the foot; *m*, pallial line.

Sub-genus, *Yoldia*, Möller (dedicated to the Countess Yoldi). Y. myalis, Pl. XVII. fig. 21. *Shell* oblong, slightly attenuated behind, compressed, smooth or obliquely sculptured, with dark olive shining epidermis; external ligament slight; cartilage as in Leda; pallial sinus deep. *Animal* with the branchial and anal siphons united, retractile; palpi very large, appendiculate; gills narrow, posterior; foot slightly heeled, deeply grooved, its margins crenulated; intestine lying partly close to the right side of the body, and producing an impression in the shell; mantle-margin plain in front, fringed behind; destitute of ventral lobes. *Distr.* Arctic and Antarctic Seas; Greenland, Mass. Brazil; Norway, Kamtschatka. *Fossil*, *Miocene* —. (Crag and Glacial deposits.) England, Belgium.

SOLENELLA, Sowerby.

Type, S. Norrisii, Pl. XVII. fig. 22. S. ornata, fig. 23.
Syn. Malletia, Desm. Ctenoconcha, Gray. Neilo, Adams.

Shell oval or ark-shaped, compressed, smooth or concentrically furrowed, epidermis olive; ligament external, elongated, prominent: hinge with an anterior and posterior series of fine sharp teeth; interior sub-nacreous; pallial sinus large and deep; anterior adductor giving off a long oblique pedal line.

Animal like *Yoldia;* mantle-margins slightly fringed and furnished with ventral lobes; siphonal tubes united, long and slender, completely retractile; palpi appendiculate, convoluted, as long as the shell; gills narrow, posterior; foot deeply cleft, forming an oval disk, even-margined and striated across.

Distr. 2 sp. Valparaiso; New Zealand (shell like *S. ornata*).

Fossil, 1 sp. Miocene. Pt. Desire, Patagonia.

? SOLEMYA, Lamarck.

Type, S. togata, Pl. XXII. fig. 17. *Syn.* Solenomya, Menke.

Shell elongated, cylindrical, gaping at each end; epidermis dark, horny, extending beyond the margins; umbones posterior; hinge edentulous; ligament concealed; pallial line obscure. Outer layer of long prismatic cells, nearly parallel with the surface, and mingled with dark cells, as in *Pinna;* inner layer also cellular.

Animal with the mantle lobes united behind, with a single siphonal orifice, hour-glass shaped, and cirrated; foot proboscidiform, truncated and fringed at the end; gills forming a single plume on each side, with the laminæ free to the base; palpi long and narrow, nearly free.

The shell resembles *Glycimeris* in the shortness of its posterior side, and the extraordinary development of its epidermis; the animal most resembles *Leda* in the structure of its foot and gills.

Distr. 4 sp. U. States, Canaries, W. Africa (Gaboon R.), Medit. Australia, New Zealand. Burrowing in mud; 2 fms.

Fossil, 4 sp. Carb. —. Brit. Belgium.

FAMILY V. TRIGONIADÆ.

Shell equivalve, close, trigonal, with the umbones directed posteriorly; ligament external; interior nacreous; hinge-teeth few, diverging; pallial line simple.

Animal with the mantle open; foot long and bent; gills two on each side, recumbent; palpi simple.

TRIGONIA, Bruguiere (not Aublet.)

Etym. Trigonos, three-angled. *Syn.* Lyriodon, G. Sby.

Ex. T. costata, Pl. XVII. fig. 24. T. pectinata, fig. 183.

Shell thick, tuberculated, or ornamented with radiating or concentric ribs; posterior side angular; ligament small and prominent; hinge-teeth 2.3, diverging, transversely striated; centre tooth of left valve divided; pedal impressions in front of the posterior adductor, and one in the umbo of the left valve; anterior adductor impression close to the umbo.

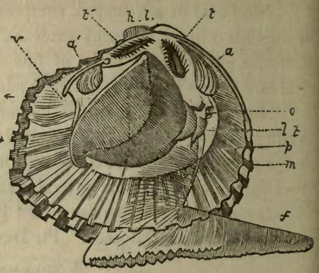

Fig. 183. *Trigonia pectinata.*‡

Animal with a long and pointed foot, bent sharply, heel prominent, sole bordered by two crenulated ridges; palpi small and pointed; gills ample, the outer smallest, united behind the body to each other and to the mantle.

The shell of Trigonia is almost entirely nacreous, and usually wanting or metamorphic in limestone strata; casts of the interior are called "horse-heads" by the Portland quarry-men;* they spoil the stone. Silicified casts have been found at Tisbury, in which the animal itself, with its gills, was preserved.† The species with the posterior angle of the shell elongated, have a siphonal ridge inside. The epidermal layer of the recent shell consists of nucleated cells, forming a beautiful microscopic object. A Trigonia placed by Mr. S. Stutchbury on the gunwale of his boat leapt overboard, clearing a ledge of four inches; they are supposed to be migratory, as dredging for them is very uncertain, though they abound in some parts of Sydney Harbour.

Distr. 3 sp. (or varieties ?) Australia.

Fossil, 100 sp. Trias — Chalk; (not known in Tertiaries). Europe, U. S. Chile, Algeria, Cape, S. India.

MYOPHORIA, Bronn, 1830.

Type, M. vulgaris, Schl. *Syn.* Cryptina (Kefersteinii) Boue.

Shell trigonal, umbones turned forwards; obliquely keeled; smooth or sculptured; teeth 2.3, striated obscurely, centre tooth of left valve simple, anterior of right valve prominent; mould like *Trigonia. M. decussata,* Pl. XVII. fig. 25, has a lateral tooth at the dorsal angle of the left valve.

Fossil, 13 sp. Trias: Germany, Tyrol.

AXINUS, Sowerby, 1821.

Type, A. obscurus, Sby. *Syn.* Schizodus, King (not Waterhouse).

Shell trigonal, rounded in front, attenuated behind; rather thin, smooth, with an obscure oblique ridge; ligament external; hinge-teeth 2.3, smooth, rather small; anterior adductor slightly impressed, removed from the hinge, with a pedal scar close to it; pallial line simple.

Fossil, 20 sp. U. Silurian — Muschelkalk. U. States, Europe. *Mactra* trigona, Goldf. *Isocardia* axiniformis. Ph. *Anodontopsis* securiformis, *Anatina* attenuata and *Dolabra* securiformis, M'Coy, probably belong to this genus. *Dolabra* equilateralis, *Amphidesma* subtruncatum, *Anodontopsis* angustifrons, M'Coy, with many others from the Palæozoic rocks, may constitute a distinct genus, but their generic character has yet to be discovered.

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* See Plott's Oxfordshire, T. vii. fig. 1.

† In the collection of the late Miss Benett of Warminster, now in Philadelphia.

‡ Fig. 183. From a specimen in alcohol; the gills slightly curled and contracted, they should terminate near the margin, between the arrows which indicate the inhalent and exhalent currents: *a,a'*, adductors; *hl*, ligament; *t. t'*, dental sockets; *o*, mouth; *lt*, labial tentacles or palpi; *p*, pallial line; *m*, margin; *f*, foot; *v*, cloaca.

LYRODESMA, Conrad, 1841.

Type, L. plana, New York. *Syn.* Actinodonta, Phil.

Shell trigonia-shaped, rather elongated, with a striated posterior area; hinge with several (5—9) radiating teeth, striated across; ligament external.

Fossil, 3 sp. L. Silurian: Canada, U. States, Brit.

FAMILY VI. UNIONIDÆ. Naïdes.

Shell usually regular, equivalve, closed; structure nacreous, with a very thin prismatic-cellular layer beneath the epidermis; epidermis thick and dark; ligament external, large and prominent; margins even; anterior hinge-teeth thick and striated, posterior laminar, sometimes wanting; adductor scars deeply impressed; pedal scars 3, distinct, 2 behind the anterior adductor, one in front of the posterior.

Animal with the mantle-margins united between the siphonal orifices and, rarely, in front of the branchial opening; anal orifice plain, branchial fringed; foot very large, tongue-shaped, compressed, byssiferous in the fry; gills elongated, sub-equal, united posteriorly to each other and to the mantle, but not to the body; palpi moderate, laterally attached, striated inside: lips plain. Sexes distinct.

The river-mussels are found in the ponds and streams of all parts of the world. In Europe the species are few, though specimens are abundant; in N. America both species and individuals abound. All the remarkable generic forms are peculiar to S. America and Africa. Two of these are fixed, and irregular when adult, and have been placed with the chamas and oysters by the admirers of artificial systems; fortunately, however, M. D'Orbigny has ascertained that the *Mulleria,* which is fixed and *mono-myary* when adult, is locomotive and di-myary when young![*]

Like other fresh-water shells, the naïds are often extensively eroded by the carbonic acid dissolved in the water they inhabit (p. 41).[†] This condition of the umbones is conspicuous in the great fossil *Uniones* of the Wealden, but cannot be detected in the *Cardiniæ,* and some other fossils formerly referred to this family.

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[*] In the synopsis at p. 252 it will be seen that each of the principal groups of bivalves contains members which are fixed and irregular, and others which are byssiferous, or burrowing, or locomotive.

[†] Probably many of the organic acids, produced by the decay of vegetable matter, assist in the process. It has been suggested that sulphuric acid may sometimes be set free in river-water, by the decomposition of iron-pyrites in the banks: but Prof. Boye of Philadelphia states that it has not been detected in any river of the United States, where the phenomenon of erosion is most notorious.

The outer gills of the female unionidæ are filled with spawn in the winter and early spring; the fry spins a delicate, ravelled byssus, and flaps its triangular valves with the posterior shell-muscle, which is largely developed, whilst the other is yet inconspicuous. The shells of the female river-mussels are rather shorter and more ventricose than the others. (See pp. 18, 34.)

UNIO, Retz. River-mussel.

Etym. *Unio* a pearl (Pliny). *Ex.* U. litoralis, Pl. XVIII. fig. 1.

Shell oval or elongated, smooth, corrugated, or spiny, becoming very solid with age; anterior teeth 1.2 or 2.2, short, irregular; posterior teeth 1.2, elongated, laminar.

Animal with the mantle-margins only united between the siphonal openings; palpi long, pointed, laterally attached. (Fig. 172, p. 246.)

U. plicatus (Symphynota, Sw. Dipsas, Leach) has the valves produced into a thin, elastic dorsal wing, as in *Hyria.** In the Pearl-mussel, *U. margaritiferus* (Margaritana, Schum. Alasmodon, Say) the posterior teeth become obsolete with age. This species, which afforded the once famous British pearls, is found in the mountain streams of Britain, Lapland, and Canada; it is used for bait in the Aberdeen Cod-fishery. The Scotch pearl-fishery continued till the end of the last century, especially in the R. Tay, where the mussels were collected by the peasantry before harvest-time. The pearls were usually found in old and deformed specimens; round pearls about the size of a pea, perfect in every respect, were worth £3 or £4. (Dr. Knapp.) An account of the Irish pearl-fishery was given by Sir R. Redding in the Phil. Trans. 1693. The mussels were found set up in the sand of the river-beds with their open side turned from the torrent; about one in 100 might contain a pearl, and one pearl in 100 might be tolerably clear. (See p. 38.)

Distr. 250 sp. N. America, S. America, Europe, Africa, Asia, Australia.

Fossil, 50 sp. Wealden —. Europe, India.

Sub-genera, Monocondylæa, D'Orb. M. Paraguayana, Pl. XVIII. fig. 2. *Shell* with a single large, round, obtuse cardinal tooth in each valve; no lateral teeth. *Distr.* 6 sp. S. America.

Hyria, Lam. H. syrmatophora, Pl. XVIII. fig. 3. *Syn.* Pachyodon and Prisodon, Schum. *Shell* Arca-shaped, hinge-line straight, with a dorsal wing on the posterior side; teeth elongated, transversely striated. *Distr.* 4 sp. S. America.

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* This is the species in which the Chinese produce artificial pearls by the introduction of shot, &c., between the mantle of the animal and its shell (p. 38); Mr. Gaskoin has an example containing two strings of pearls, and another in the Brit. Mus. has a number of little josses made of bell-metal, now completely coated with pearl, in its interior.

CASTALIA, Lamarck.

Type, C. ambigua, Pl. XVIII. fig. 4. *Syn.* Tetraplodon, Spix.

Shell ventricose; trigonal; umbones prominent, furrowed; hinge-teeth striated; anterior 2.1, short; posterior 1.2, elongated.

Animal with mantle-lobes united behind, forming two distinct siphonal orifices, the branchial cirrated.

Distr. Rivers of S. America, Guiana, Brazil.

ANODON, Cuvier. Swan-mussel.

Type, A. cygneus, fig. 171. p. 245. *Etym. Anodontos*, edentulous.

Shell like *unio*, but edentulous; oval, smooth, rather thin, compressed when young, becoming ventricose with age.

Animal like unio: the outer gills of a female have been computed to contain 600,000 young shells (*Lea*). See p. 19.

Distr. 50 sp. N. America, Europe, Siberia. *Fossil*, 5 sp. Eocene —. Europe.

M. D'Orbigny relates that he found great quantities of small Anodons (*Bysso-anodonta Paraniensis*, D'Orb.) 4 lines in length, *attached by a byssus*, in the R. Parana, above Corrientes.

IRIDINA, Lamarck.

Syn. Mutela, Scop. Spatha, Lea (including *Mycetopus*).

Type. I. exotica, Pl. XVIII. fig. 5. *Etym. Iris*, the rainbow.

Shell oblong; umbones depressed; hinge-line long, straight, attenuated towards the umbones, crenated by numerous unequal teeth; ligament long and narrow.

Animal with mantle-lobes united posteriorly, forming two short siphons; mouth and lips small; palpi immense, oval; gills united to the body.

Iridina ovata (Pleiodon, Conrad), has a broader hinge-line.

Distr. 6 sp. Rivers of Africa, Nile, Senegal.

MYCETOPUS, D'Orbigny.

Etym. Mukes a mushroom, *pous* the foot.

Type, M. soleniformis, Pl. XVIII. fig. 6.

Shell elongated, sub-cylindrical, gaping in front; margins sub-parallel, hinge edentulous.

Animal with an elongated, cylindrical foot, expanded into a disk at the end; mantle open; gills equal; palpi short.

Distr. 3 sp. R. Parana, Corrientes; R. Amazon, Bolivia.

ÆTHERIA, Lamarck.

Type, Æ. semilunata, Pl. XVIII. fig. 7. (*aitherios*, aërial.)

Shell irregular, inequivalve; attached by the umbo, and tubular processes of one of the valves, usually the left; epidermis thick, olive; interior pearly, blistered (as if with air-bubbles); hinge edentulous; ligament external, with a conspicuous area and groove in the fixed valve; two adductor impressions, the anterior very long and irregular; pallial line simple.

Animal with the mantle-lobes open; body large, oblong, projecting backwards; no trace of a foot; palpi large, semi-oval; gills sub-equal, plaited, united posteriorly, and to the body and mantle.

Distr. R. Nile, from 1st Cataracts to Fazool;* R. Senegal.

MULLERIA, Férussac.

Dedicated to Otto Frid. Müller, author of the "Zoologia Danica."

Type, M. lobata, Fér. *Syn.* Acostæa (Guaduasana) D'Orb.

Shell when *young* free, equivalve, Anodon-shaped, with a long and prominent ligament, and two adductor impressions: *adult* irregular, inequivalve, attached by the right valve; umbones elongated, progressively filled up with shell, and forming an irregular "talon" in front of the fixed valve; epidermis thick; ligament in a marginal groove; interior pearly, muscular impression single, posterior.

Distr. R. Magdalena, near Bogota, New Granada.

Mr. Isaac Lea has determined the identity of *Mülleria* and *Acostæa* by examination of Férussac's type, and the suite of specimens, of different ages, in the collection of M. D'Orbigny.†

SECTION B. SIPHONIDA.

Animal with respiratory siphons; mantle-lobes more or less united.

a. Siphons short, pallial line simple; Integro-pallialia,

FAMILY VII. CHAMIDÆ.

Shell inequivalve, thick, attached; beaks sub-spiral; ligament external; hinge-teeth 2 in one valve, 1 in the other; adductor impressions large, reticulated; pallial line simple.

Animal with the mantle closed; pedal and siphonal orifices small, subequal; foot very small; gills two on each side, very unequal, united posteriorly.

CHAMA (Pliny) L.

Ex. C. macrophylla, Pl. XVIII. figs. 8, 9. *Syn.* Arcinella, Schum.

Shell attached usually by the *left* umbo; valves foliaceous, the upper smallest; hinge-tooth of free valve thick, curved, received between two teeth, in the other; adductor impressions large, oblong, the anterior encroaching on the hinge-tooth.

Animal with the mantle-margins united by a curtain, with two rows of tentacular filaments; siphonal orifices wide apart, branchial slightly prominent, fringed, anal with a simple valve; foot bent, or heeled; liver occupying the umbo of the attached valve only; ovary extending into both mantle-lobes, as far as the pallial line; lips simple, palpi small and curled; gills leeply plaited, the outer pair much shorter and very narrow, furnished with a ree dorsal border, and united behind to each other, and to the mantle; adluctors each composed of two elements.

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* The "fresh-water oysters" discovered by BRUCE.

† The only specimen of Mülleria in England was purchased many years ago by Mr. Thos. Norris, of Bury, for £20.

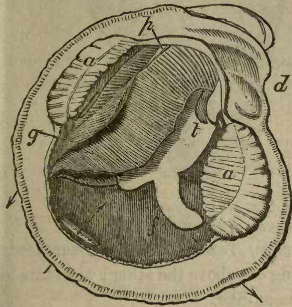


Fig. 184. *Right Side.*

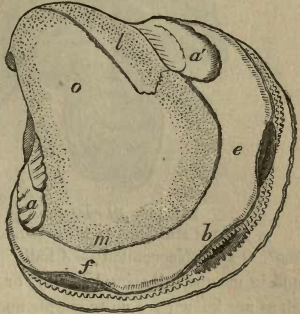


Fig. 185. *Left side.*

Animal of Chama (from Torres Str. Mr. Jukes.)

Fig. 184. Right side, with the umbonal portion of the mantle removed.

Fig. 185. Left side, showing the relative extent of the liver and ovarium.

a, *a*, adductors; *m*, pallial line; *e*, excurrent orifice; *b*, branchial; *f*, foot and edal orifice; *p*, posterior pedal muscle; *t*, palpi; *g*, gills (contracted); *l*, liver; *o*, varium; *d*, dental lobes.

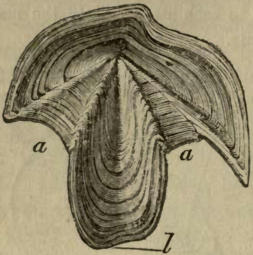
The shell of *Chama* consists of three layers; the external, coloured layer s laminated by oblique lines of growth, with corrugations at right angles to the aminæ; the foliaceous spines contain reticulated tubuli: the middle layer is paque white and consists of ill-defined vertical prisms or corrugated strucure; the inner layer, which is translucent and membranous, is penetrated y scattered vertical tubuli; the minute processes that occupy the tubuli ive to the mantle (and to the casts of the shell) a granular appearance (fig. 85, *l*, *m*.)

Some Chamas are attached indifferently by either valve; when fixed by he right valve the dentition is reversed, the left valve having the single ooth. *Chama arcinella,* which is always attached by the right umbo, has he normal dentition 1 : 2; it is nearly regular and equivalve, and has a disinct lunule.

Distr. 50 sp. Tropical seas, especially amongst coral-reefs; — 50 fms. V. Indies, Canaries, Medit. India, China.

Fossil, 30 sp. Green-sand —. U. States, Europe.

Sub-genus ? Monopleura; Matheron (= Dipilidia, Math) *M. imbriata,* Math. Fig. 187. Neocomian, S. France. *Shell* attached by the *extral* umbo; valves alike in structure and sculpturing; fixed valve straight, nversely conical, with a long, straight ligamental groove, and obscure hingerea; opercular valve flat or convex, with an oblique, sub-marginal umbo.



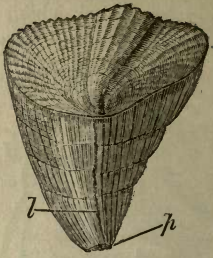
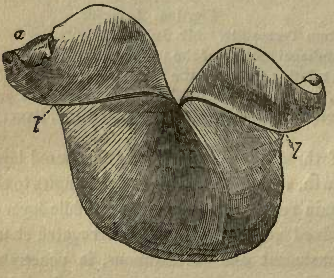


Fig. 186. *Bi-radiolites*, ⅗. Fig. 187. *Monopleura*, ½.
p, point of attachment; *l*, ligamental groove; *a*, *a*, corresponding areas.

Fossil, 9 sp. Neocomian — Chalk. France, Texas. They are commonly found in groups, adhering laterally, or rising one above the other; the casts of such as are known are quite simple and chama-like.



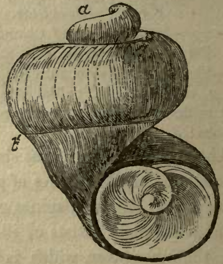


Fig. 188. *Diceras arietinum*, ½. Fig. 189. *Requienia ammonia*, ¼.
a, point of attachment; *l*, *l*, ligamental grooves; *t*, posterior adductor inflection.

Diceras, Lamarck.

Type, D. arietinum, Pl. XVIII. figs. 10, 11, and fig. 188, 190.

Shell sub-equivalve, attached by either umbo; beaks very prominent, spiral, furrowed externally by ligamental grooves; hinge very thick, teeth 2.1, prominent; muscular impressions bounded by long spiral ridges, sometimes obsolete.

Distr. 5 sp. Middle oolite. Germany, Switz. France, Algeria.

Diceras differs from *Chama* in the great prominence of both its *umbones*, in having constantly two hinge-teeth in the right valve and one in the left, and in the prominent ridges bordering the muscular impressions. Similar ridges exist in *Cucullæa*, *Megalodon*, *Cardilia* and the Hippurite; they produce deep spiral furrows on the casts, which are of common occurrence in the Coral-oolite of the Alps. One or both the anterior furrows (fig. 190, *t*, *t*) are frequently obsolete. The dental pits are much deeper than the teeth which hey receive, and are sub-spiral, giving rise to bifid projections (*c*, *c*) on the asts; the single tooth in the left valve consists of two elements, and the avity (*fosset*) which receives it is divided at the bottom.

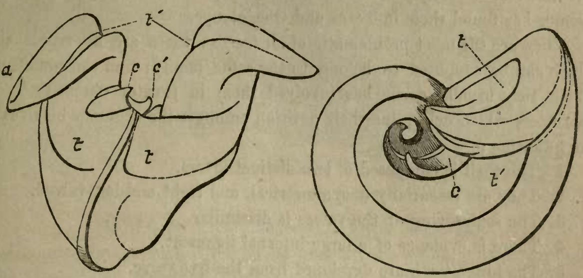


Fig. 190. *Diceras*, ¼. Fig. 191. *Requienia*, ½.

Internal casts: *a*, point of attachment; *c*, *c'*, casts of dental pits; *t*, *t'*, furrows produced by spiral ridges. (Mus. Brit.)

REQUIENIA, Matheron.

Dedicated to M. Requien, author of a Catalogue of Corsican Mollusca.

Ex. R. Lonsdalii, Pl. XVIII. fig. 12 and fig. 191. R. Ammonia, fig. 189.

Shell thick, very inequivalve, attached by the *left* umbo; ligament external; teeth 2:1; left valve spiral, its cavity deep, not camerated; free valve smaller, sub-spiral; posterior adductor bordered by a prominent sub-spiral ridge in each valve.

The shell-structure of *Requienia* is like that of *Chama.* The relative size of the valves is subject to much variation; in *R. Favri* (Sharpe) they are nearly equal. The hinge-teeth are like those of *Diceras;* the cavity for the posterior tooth of the right valve is very deep and sub-spiral (fig. 191, *c'*). The internal muscular ridges are produced by duplicatures of the shell-wall, and are indicated outside by grooves (fig. 189, *t'*). In *R. sub-æqualis* and *Toucasiana* there is a second parallel ridge, as in Hippurites and *Caprotina.*

Fossil, 7 sp. Neocomian — L. Chalk. Brit. France, Spain, Algeria, Texas.

FAMILY VIII. HIPPURITIDÆ.

(Order *Rudistes*, Lamarck.)

Shell inequivalve, unsymmetrical, thick, attached by the *right* umbo; umbones frequently camerated; structure and sculpturing of valves dissimilar; ligament internal; hinge-teeth 1 : 2; adductor impressions 2, large, those of the left valve on prominent apophyses; pallial line simple, submarginal.

The shells of this extinct family are characteristic of the cretaceous strata, and abound in many parts of the Peninsula, the Alps and E. Europe where the equivalent of the Lower Chalk has received the name of "Hippurite limestone." They occur also in Turkey and in Egypt, and Dr. F Rœmer has found them in Texas and Guadaloupe.

They are the most problematic of all fossils: there are no recent shells which can be supposed to belong to the same family; and the condition in which they usually occur has involved them in greater obscurity.* The characters which determine their position amongst the ordinary bivalves are the following:—

1. The shell is composed of two distinct layers.
2. They are essentially unsymmetrical, and right-and-left valved.
3. The sculpturing of the valves is dissimilar.
4. There is evidence of a large internal ligament.
5. The hinge-teeth are developed from the free valve.
6. The muscular impressions are 2 only.
7. There is a distinct pallial line.

The outer layer of shell in the Hippurite and Radiolite consists of prismatic cellular structure (fig. 123); the prisms are perpendicular to the shell-laminæ, and subdivided often minutely. The cells appear to have been empty, like those of *Ostrea* (p. 254).† The inner layer, which forms the hinge and lines the umbones is sub-nacreous, and very rarely preserved. It is usually replaced by calcareous spar (fig. 200), sometimes by mud or chalk, and very often it is only indicated by a vacuity between the outer shell and the internal mould (fig. 205). The inner shell-layer is seldom compact, its lamellæ are extremely thin, and separated by intervals like the water-chambers of *Spondylus;* similar spaces occur in the deposit, filling the umbonal cavity of the long-beaked oysters.‡

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* 1. Buch regarded them as Corals. 1840, Leonh. and Bronn Jahrb. p. 573.

2. Desmoulins, as a combination of the Tunicary and Sessile Cirripede.

3. Dr. Carpenter, as a "group intermediate between the *Conchifera* and *Cirripeda.*" An. Nat. Hist. XII. 390.

4. Prof. Steenstrup, of Copenhagen, as Anellides.

5. Mr. D. Sharpe refers *Hippurites* to the Balani; *Caprinella* to the Chamaceæ.

6. Lapeirouse considered the Hippurites *Orthocerata;* the Radiolites, *Ostracea.*

7. Goldfuss and D'Orbigny place them both with the *Brachiopoda.*

8. Lamarck and Rang, between the *Brachiopoda* and *Ostraceæ.*

9. Cuvier and Owen, with the Lamellibranchiate bivalves.

10. Deshayes, in the same group with *Ætheria.*

11. Quenstedt, between the *Chamaceæ* and *Cardiaceæ.*

† This is very conspicuous in *Radiolites* from the Chalk; a formation in which other prismatic-cellular fossils are solid.

‡ The water-chambers in some of the cylindrical Hippurites are large and regular, like those of the fossil corals *Amplexus* and *Cyathophyllum.* A section of *Hippurites bi-oculatus* passing through only one of the dental sockets, resembles an *Orthoceras* with a lateral siphuncle; whilst a *Caprinella* (fig. 207), which has lost its outer layer, might be mistaken for a sort of *Ammonite.*

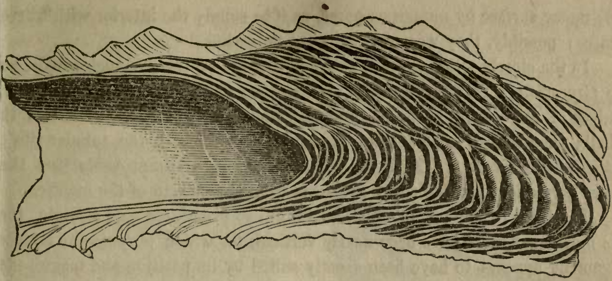

Fig. 192. Section of a fragment of *Ostrea cornucopiæ.*

The inner layer ceases at the pallial line, beyond which, on the rim of the hell, the cellular structure is often apparent; obscure bifurcating impressions radiate from the pallial line to the outer margin, (fig. 193, *v, v.*)

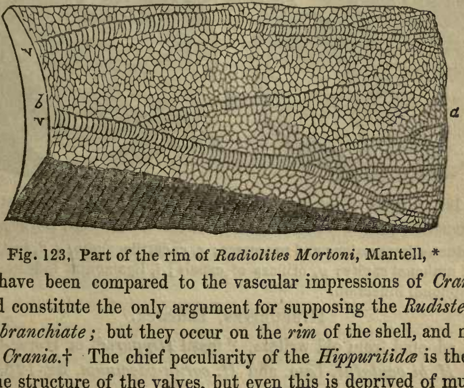

Fig. 123, Part of the rim of *Radiolites Mortoni*, Mantell, *

These have been compared to the vascular impressions of *Crania.* (figs. 157, 8) and constitute the only argument for supposing the *Rudistes* to have een *palliobranchiate;* but they occur on the *rim* of the shell, and not on the lisk, as in *Crania.*† The chief peculiarity of the *Hippuritidæ* is the dissimiarity in the structure of the valves, but even this is deprived of much signiicance by its inconstancy.‡ The free valve of *Hippurites* is perforated by adiating canals which open round its inner margin, and communicate with the upper surface by numerous pores, as if to supply the interior with filtered water; possibly, they were closed by the epidermis.*

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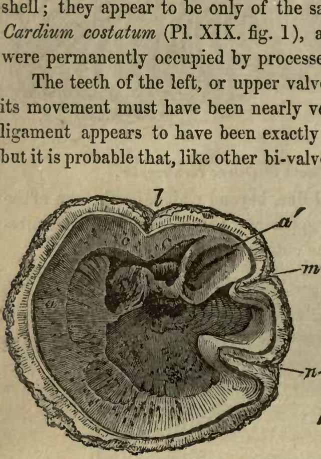
* Traced from the original specimen in the Museum of the School of Mines. *b*, s the inner edge: *a*, the outer edge; *v*, *v*, the dichotomous impressions; the horiontal laminæ are seen on the shaded side. Lower Chalk; Sussex.

† M. D'Orbigny considers they were produced by peculiar appendages to the nantle-margin, which, in *Hippurites*, were prolonged into the canals of the upper alve.

‡ The lower valves of some *Spondyli* are squamous or spiny, the upper plain; hose of many oysters Pectens and some Tellens are diversely sculptured; but in no nstance is the internal structure of the two valves different ? The inconstancy of he shell-structure in the *Rudista* has a parallel in *Rhynchonella* and *Terebratula* p. 213), and in the condition of the hepatic organ in *Tritonia* and *Dendronotus.*

In the closely allied genus *Radiolites* there is no trace of such canals, nor in *Caprotina.* Those which exist in the upper valve of *Caprina,* and in both valves of *Caprinella,* have no communication with the outer surface of the shell; they appear to be only of the same character with the tubular ribs of *Cardium costatum* (Pl. XIX. fig. 1), and it is highly improbable that they were permanently occupied by processes from the margin of the mantle.

The teeth of the left, or upper valve, are so prominent and straight, that its movement must have been nearly vertical, for which purpose the internal ligament appears to have been exactly suited by its position and magnitude; but it is probable that, like other bi-valves, they opened to a very small extent.



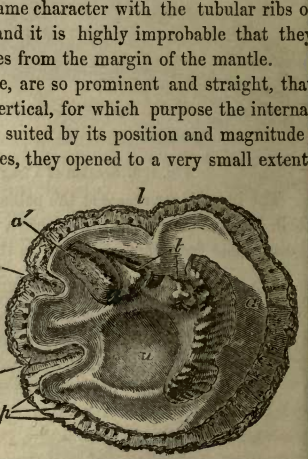


Fig. 194. *Interior of lower valve,* ½. Fig. 195. *Upper valve* (restored).
Hippurites radiosus, Desm. Lower Chalk, St. Mamest, Dordogne.†

a, a, adductor impressions and processes; *c, c,* cartilage pits; *t, t′,* teeth and dental sockets; *u,* umbonal cavity; *p,* orifices of canals; *l,* ligamental inflection; *m,* muscular; *n,* siphonal inflection.

HIPPURITES, Lamarck.

Name, adopted from old writers, "fossil *Hippuris*" or Horse-tail.

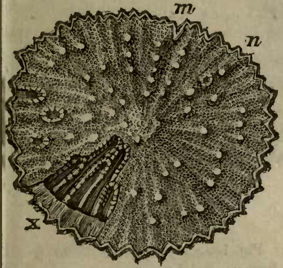
Types, H. bi-oculatus, Lam. and *H. cornu-vaccinum,* fig. 198.

Shell very inequivalve, inversely conical, or elongated and cylindrical; *fixed valve* striated or smooth, with three parallel furrows (*l, m, n,*) on the cardinal side, indicating duplicatures of the outer shell layer: internal margin slightly plaited; pallial line continuous; umbonal cavity moderately deep, ligamental inflection (*l*) with a small cartilage-pit on each side (*c, c*); dental sockets sub-central, divided by an obsolete tooth; anterior muscular impression (*a*) elongated, double; posterior (*a′*) small, very deep, bounded by the second duplicature (*m*); third duplicature (*n*) projecting into the umonal cavity: *free valve* depressed, with a central umbo, and two grooves r pits corresponding to the posterior ridges in the lower valve; surface orous, the pores leading to canals in the outer shell-layer, which open round he pallial line upon the inner margin; anterior cartilage-pit deep and conical,

---

* The valves of *Crania* are perforated by branching tubuli, but in that case they pass *vertically* through every part of the shell, and all its layers (p. 214.)

† From the original in the Brit. M. The inner layer of shell in this species has an irregularly cellular structure, to which its preservation is due.



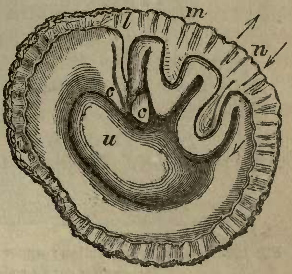


Fig. 196. *H. Toucasianus, upper valve,* ½.* Fig. 197. *Lower valve, with mould,* ⅔. *l*, ligamental; *m*, muscular; *n*, siphonal inflections; *x*, fracture, showing canals; , cartilage: *u*, left umbo; the arrows indicate the probable direction of thebranchial urrents.

osterior shallow; umbonal cavity turned to the front (*u*); teeth 2, straight, ub-central, the anterior largest, each supporting a crooked muscular apohysis, the first broad, the hinder prominent, tooth-like; inflections (*m*, *n*) urrounded by deep channels.

H. cornu-vaccinum attains a length of more than a foot, and is curved like a cow's-horn; the outer layer separates readily from the core, which is furrowed longitudinally, The ligamental inflection (*l*) is very deep and narrow, and the anterior tooth further removed from the side than in *H. bi-oculatus* and *radiosus* (figs. 194, 5); the posterior apophysis (*a*') does not nearly fill the corresponding cavity in the lower valve. In *H. bi-oculatus* and some other species there is no ligamental ridge inside; these, when they have lost their inner layer, present a cylindrical cavity with two parallel ridges, extending down one side. The third inflection (*n*) is possibly a siphonal fold, such as exists in the tube of *Teredo*, and sometimes in the valves of *Pholas*, *Clavagella*, and the caudate species of *Trigonia*.

The development of processes from the upper valve, for the attachment of the adductor muscles harmonizes with the other peculiarities of the Hippurite. The equal growth of the margins of the valves produces central umbones, and necessitates an internal cartilage; this again causes the removal

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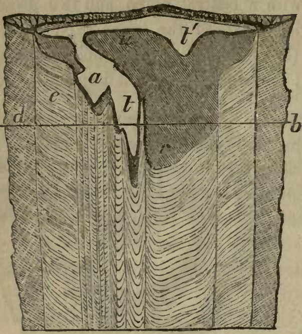
* This internal mould, representing the form of the animal, was obtained by removing the upper valve piecemeal with the chisel; a plaster-cast taken from it represents the interior of the upper valve, with the bases of the teeth and apophyses. See originals in Brit. Mus.



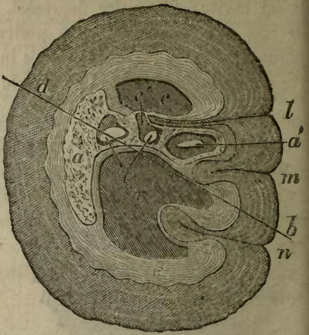
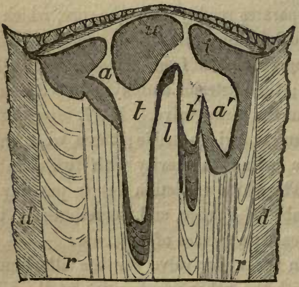


Fig. 198. Longitudinal section; upper half, ½. Fig. 199. Transverse section, ⅓.
Hippurites cornu-vaccinum, Bronn. Salzburg.

l, m, n, duplicatures; *u,* umbonal cavity of left valve; *r,* of right valve; *c, c',* cartilage-pits; *t, t',* teeth; *a, a',* muscular apophyses; *d,* outer shell-layer, Fig. 198 is taken in the line *d, b,* of fig. 199, cutting only the base of the posterior tooth (*t'*). Fig. 199, is from a larger specimen, at about the level *d, b* of fig. 198, cutting the point of the posterior apophysis (*a'*), and shewing the peculiar shell-texture deposited by the anterior adductor (*a*).

of the teeth and adductors further from the hinge-margin, to a position in which the muscles must have been unusually long, unless supported in the manner described. Supposing the animal to have had a small foot,* like



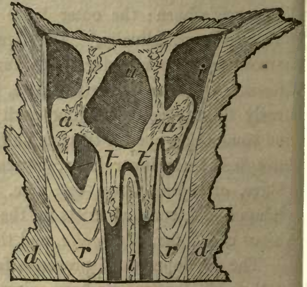


Fig. 200. *Hippurites cornu-vaccinum.* Fig. 201. *Radiolites cylindraceus,* ½.
Longitudinal sections taken through the teeth (*t, t'*) and apophyses (*a, a'*).
d, outer, *r,* inner shell-layer; *l,* dental plate of lower valve; *u,* umbonal cavity of upper valves; *i,* intestinal channel. Originals in Brit. M.

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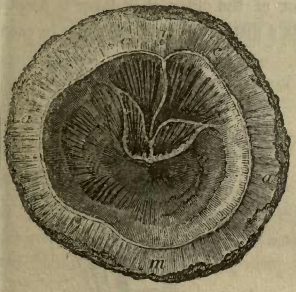
* This is extremely doubtful; since p. 253 was printed, we have examined an authentic specimen of *Aetheria,* and find that Rang and Cailliaud's account is incorrect: *it has no foot.*

hama, the mantle-opening for that organ would have been completely ob-ructed by the adductor, but that the muscular support was hook-shaped ig. 200, *a*). The posterior adductor-process is similarly under-cut for the assage of the rectum, which in all bivalves emerges between the hinge and osterior adductor, winds round outside that muscle and terminates in the ne of the exhalent current. There is a groove (sometimes an inch deep) ound the second and third duplicatures in the upper valve, which seems in-ended to facilitate the passage of the alimentary canal, and the flow of water om the gills into the exhalent channel. The smallness of the space for the ranchiæ may have been compensated by deep plication of those organs, as 1 *Chama* and *Tridacna*.

Fossil, 16 sp. Chalk. Bohemia, Tyrol, France, Spain, Turkey, Syria lgeria, Egypt.



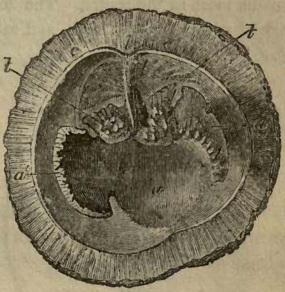
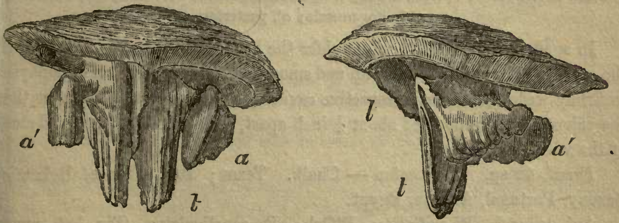


Fig. 202. Interior of lower valve. **Fig. 203.** Interior of upper valve.
***Radiolites mammillaris*, Math. ½ L. Chalk. S. Mamest, Dordogne.**
, ligamental inflection; *m*, pallial line; *c, c*, cartilage pits; *a, a*, adductor impressions and processes; *t*, teeth and dental sockets.

Radiolites, Lamarck, 1801.

Etym. Radius, a ray. *Syn.* Sphærulites, De la Metherie, 1805.



ig. 204. Side views of the upper valve of *R. mammillaris*;[1] *l*, ligamental inflection *t*, teeth; *a, a′*, muscular processes.

Shell inversely conical, bi-conic, or cylindrical; valves dissimilar in structure; internal margins smooth or finely striated, simple, continuous; ligamental inflection very narrow, dividing the deep and rugose cartilage pits: *lower valve* with a thick outer layer, often foliaceous; its cavity deep and straight, with two dental sockets and lateral muscular impressions; *upper valve* flat or conical, with a central umbo; outer layer thin, radiated; umbonal cavity inclined towards the ligament; teeth angular, striated, supporting curved and sub-equal muscular processes.

The upper valve of *R. fleuriausus* has an oblique umbo, with a distinct ligamental groove. The foliations of the lower valve are frequently undulated; they are sometimes as thin as paper and several inches wide.

The umbonal cavity of the lower valve is partitioned off by very delicate funnel-shaped laminæ. Specimens frequently occur in which the outer shell layer is preserved, whilst the inner is wanting, and the mould ("birostrites") remains loose in the centre. The interior of the outer shell layer is deeply grooved with lines of growth, and exhibits a distinct ligamental ridge in each valve.

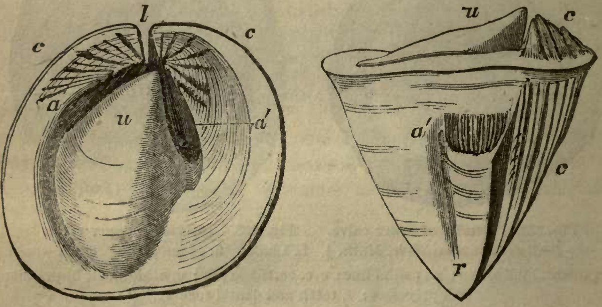


Fig. 205. Upper view. Fig. 206. Side view.

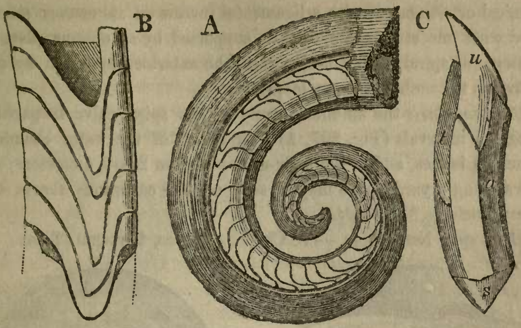
Internal mould of *R. Hæninghausii*, Desm. ½. Chalk.

u, umbo of left valve; *r*, right umbo; *l*, ligamental groove; *c*, *c*, cartilage; *a*, anterior adductor muscle; *a'*, posterior.

In aged examples of *R. calceoloides* the ligamental inflection is concealed, the cartilage pits partially filled up and smoothed, and the teeth and apophyses so firmly wedged into their respective cavities, as to suggest the notion that the valves had become fixed about ¼ inch apart, and ceased to open and close at the will of the animal.

Fossil, 42 sp. Neocomian — Chalk. Texas; Brit. France, Bohemia, Saxony, Portugal, Algeria, Egypt.

Sub-genus? *Bi-radiolites*, D'Orb. R. canaliculatus, (Fig. 186, upper valve). Ligamental groove visible in one or both valves, sometimes occupying the crest of a ridge, and bordered by two similar areas, (*a*, *a*.) *Fossil*, 5 sp. Chalk, France.

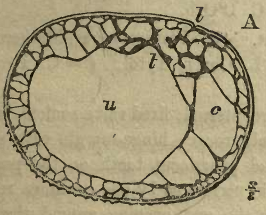


Fig, 207. *Caprinella triangularis*, Desm. U. Green-sand, Rochelle. $\frac{2}{5}$
A, portion of the left valve, after D'Orbigny,* the shell-wall is removed byweathering, exposing the camerated interior. B, mould of five of the water-chambers. C, mould of the body-chamber; *u*, umbo of right valve; *s*, of left valve; *t*, dental groove: *a*, surface from which the posterior lobe has been detached. From the originals in the Brit. M. presented by S. P. Pratt, Esq.

CAPRINELLA, D'Orbigny.

Type, C. triangularis, Desm. (Fig 207). *Syn.* Caprinula (Boissii) D'Orb.

Shell fixed by the apex of the right valve, or free; composed of a thick layer of open tubes, with a thin compact superficial lamina; cartilage internal, contained in several deep pits; umbones more or less camerated; right



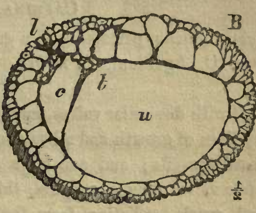


Fig. 208. Straight valve. Fig. 209. Spiral valve.
Transverse sections of *C. Boissii*, L. Chalk, Lisbon (Mr. Sharpe).
l, position of ligamental inflection; *t*, teeth; *c*, cartilage pits; *u*, umbonal cavity. Fig. 209 is from a weathered specimen, which has lost the outer layer. The tubes of the shell-wall are filled with limestone containing small shells.

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* In M. D'Orbigny's figure the smaller valve has been added from another specimen, and is turned *towards* the spire of the large valve, (Pal. Franc. pl. 542, fig. 1.) In Mr. Pratt's specimens, and those collected by M. Sharpe in Portugal, the umbo of the smaller valve is turned *away* with a sigmoid flexure. (Geol. Journ. VI. pl. 18.)

valve conical or elongated, with a ligamental furrow on its convex side, and furnished with one strong hinge-tooth supported by an oblique plate: left valve oblique or spiral, with 2 hinge-teeth, the anterior supported by a plate which divides the umbonal cavity lengthwise.

In *C. triangularis* the umbonal cavity of the spiral valve is partitioned off at regular intervals (Fig. 207, A); the length of the water chambers is sometimes 3½ inches, and of the body-chamber from 2 to 7 diameters; specimens measuring a yard across may be seen on the cavernous shores of the islets near Rochelle.* (*Pratt.*)

Fossil, 6 sp. Neocomian — L. Chalk. France, Portugal, Texas.

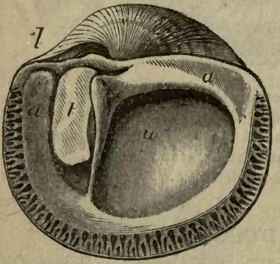

Fig. 210. *C. Aguilloni,* left valve.

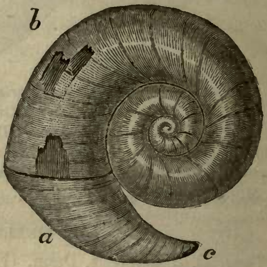

Fig 211. *C. adversa* (after D'Orb.)

a. a, position of adductors; *l,* ligament; *u,* umbonal cavity; *t,* tooth of fixed valve, broken off and remaining in its socket; *c,* original point of attachment.

CAPRINA, C. D'Orb.

Etym. Caprina, pertaining to a goat. *Syn.* Plagioptychus, Matheron.

Type, C. Aguilloni, C. D'Orb. L. Chalk, Tyrol, (= C. Partschii, Hauer.)

Shell with dissimilar valves, cartilage internal; fixed valve conical, marked only by lines of growth and a ligamental groove; hinge-margin with several deep cartilage-pits; and one large and prominent tooth on the posterior side; free valve oblique or spiral, thick, perforated by one or more rows of flattened canals, radiating from the umbo and opening around the inner margin; anterior tooth supported by a plate which divides the umbonal cavity lengthwise, posterior tooth obscure; hinge-margin much thickened, grooved for the cartilage.

In *C. adversa* (fig. 211) the free valve is (*b*) sinistrally spiral; its cavity is partitioned off by numerous septa, and divided longitudinally by the dental plate. When young it is attached by the apex of the straight valve (*c*), but afterwards becomes detached, as the large specimens are found imbedded with the spire downwards. (Saemann). The lower valve of *C. Coquandiana* is sub-spiral.

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* These singular fossils were called *ichthyosarcolites* by Desmarest, from their resemblance to the flaky muscles of fishes.

Fossil, 5 sp. U. Green-sand and L. Chalk. Bohemia, France, Texas.

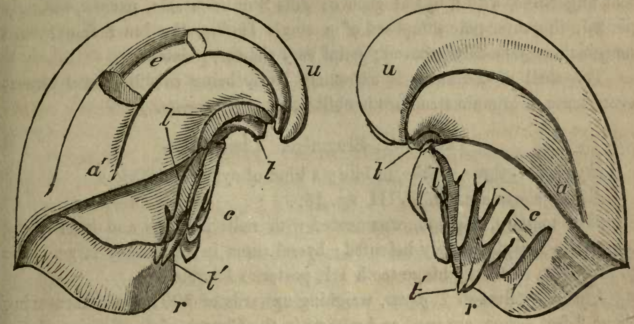

Fig. 212. Internal mould of *Caprotina quadripartita,* D'Orb. ½.
u, left umbo; *r,* right umbo; *l,* ligamental inflection; *c,* cartilage; *t, t',* dental sockets; *a, a',* position of adductors; at *e,* a portion of the third lobe is broken away.* From a specimen collected by Mr. Pratt.

CAPROTINA, D'Orbigny.

Type, C. semistriata, Pl. XIX. fig. 13, 14. Le Mans, Sarthe.

Shell composed of two distinct layers; valves alike in structure, dissimilar in sculpturing; ligamental groove slight; cartilage internal; *right valve* fixed, striated, or ribbed, with one narrow tooth between two deep pits, cartilage pits several on each side of the ligamental inflection, posterior adductor supported by a plate: *free valve* flat or convex, with a marginal umbo; teeth 2, very prominent, supported by ridges (*apophyses*) of the adductor muscles (*a, a'*), the anterior tooth connected with a third plate (*n*), which divides the umbonal cavity.

The smaller *Caprotinæ* occur in groups, attached to oyster-shells; their muscular ridges are much less developed than in the large species (fig. 212). *C. costata* is like a little Radiolite.

Fossil, 4 sp. U. Green-sand, France. (The rest are Chamas, &c.)

FAMILY IX. TRIDACNIDÆ.

Shell regular, equivalve, truncated in front; ligament external; valves strongly ribbed, margins toothed; muscular impressions blended, sub-central, obscure.

Animal attached by a byssus, or free; mantle-lobe extensively united;

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* The first and fourth lobes, those on each side of the ligamental inflection, appear to be the two divisions of a great internal cartilage, like that of the Radiolite. (Fig. 205, 206, *c, c.*)

pedal opening, large, anterior; siphonal orifices surrounded by a thickened pallial border; branchial plain; anal remote, with a tubular valve: shell-muscle single, large and round, with a smaller pedal muscle close to it behind; foot finger-like, with a byssal groove; gills 2 on each side, narrow, strongly plaited, the outer pair composed of a single lamina, the inner thick, with margins conspicuously grooved; palpi very slender, pointed.

The shell of *Tridacna* is extremely hard, being calcified until almost every trace of organic structure is obliterated. (*Carpenter.*)

TRIDACNA, Bruguière. Clam-shell.

Etym. Tri- three, *dakno,* to bite; a kind of oyster. (*Pliny.*)

Ex. T. squamosa, Pl. XVIII. fig. 15.

Shell massive, trigonal, ornamented with radiating ribs and imbricating foliations; margins deeply indented; byssal sinus in each valve large, close to the umbo in front; hinge teeth 1.1, posterior laterals 2.1.

A pair of valves of *T. gigas,* weighing upwards of 500 lbs. and measuring above 2 feet across, are used as *benitiers* in the Church of St. Sulpice, Paris. (Dillwyn.) Capt. Cook states that the animal of this species sometimes weighs 20 lbs. and is good eating.*

Distr. 6 sp. Indian Ocean, China Seas, Pacific.

Fossil, T. media. *Miocene,* Poland (Pusch). *Tridacna* and *Hippopus* are found in the raised coral-reefs of Torres Straits. (Macgillivray.)

Sub-genus. Hippopus, Lamarck. H. maculatus, Pl. XVIII. fig. 16. The "bear's-paw clam" has close valves with 2 hinge-teeth in each. It is found on the reefs in the Coral Sea. The animal spins a small *byssus.*

FAMILY X. CARDIADÆ.

Shell regular, equivalve, free, cordate, ornamented with radiating ribs; posterior slope sculptured differently from the front and sides; cardinal teeth 2, laterals 1.1 in each valve; ligament external, short and prominent; pallial line simple or slightly sinuated behind; muscular impressions sub-quadrate.

Animal with mantle open in front; siphons usually very short, cirrated externally; gills 2 on each side, thick, united posteriorly; palpi narrow and pointed; foot large, sickle-shaped.

CARDIUM, L. Cockle.

Etym. Kardia, the heart. *Syn.* Papyridea, Sw.

Types, C. costatum, Pl. XIX. fig. 1. C. lyratum, fig. 2.

Shell ventricose, close or gaping posteriorly; umbones prominent, sub-central; margins crenulated; pallial line more or less sinuated.

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* "We staid a long time in the lagoon (of Keeling Id.), examining the fields of coral and the gigantic clam-shells, into which if a man were to put his hand, he would not, as long as the animal lived, be able to withdraw it."—Darwin's Journal, p. 460.

Animal with the mantle-margins plaited; siphons clothed with tentacular filaments, anal orifice with a tubular valve: branchial fringed; foot long, cylindrical, sickle-shaped, heeled.

The cockle (*C. edule*) frequents sandy bays, near low-water; a small variety lives in the brackish waters of the R. Thames, as high as Gravesend; it ranges to the Baltic, and is found in the Black Sea and Caspian. *C. rusticum* extends from the Icy Sea to the Medit. Black Sea, Caspian, and Aral. On the coast of Devon the large prickly cockle (*C. aculeatum*) is eaten.

Sub-genera. Hemicardium (Cardissa) Cuvier. C. hemicardium, Pl. XIX. fig. 3. *Shell* depressed, posterior slope flat, valves prominently keeled.

Lithocardium aviculare, Pl. XVIII. fig. 17. *Shell* triangular, keeled; anterior side very short; hinge-teeth 1.2, directed backwards; posterior laterals 2.1; anterior muscular pit minute, posterior impression large, remote from the hinge. *L. cymbulare, Lam.* exhibits slight indications of a byssal sinus in the front margins of the valves. *Fossil, Eocene,* France. These shells present considerable resemblance to *Tridacna.*

Serripes (grœnlandicus) Beck. Hinge edentulous. Arctic Seas, from C. Parry to Sea of Kara; fossil in the Norwich Crag.

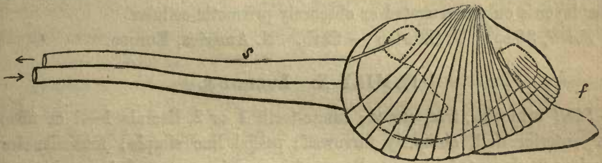

Fig. 213. C. læviusculum, Eichw. (after Middendorff.)

Adacna, Eichwald. C. edentulum, Pl. XIX. fig. 4. (Acardo, Sw. not Brug. Pholadomya, Ag. and Mid. not Sby.) *Shell* compressed, gaping behind, thin, nearly edentulous; pallial line sinuated. *Animal* with the foot (*f*) compressed; siphons (*s*) elongated, united nearly to the end, plain. *Distr.* 8 sp. Aral, Caspian, Azof, Black Sea, and the embouchures of the Wolga, Dnjestr, Dnjepr, and Don; burrowing in mud. *C. Caspicum* (Monodacna, Eichw.) has a single hinge-tooth, and *C. trigonoides* (Didacna, E.) rudiments of two teeth. The siphonal inflection varies in amount.

Distr. 200 sp: World-wide; from the sea-shore to 140 fathoms. Gregarious on sands and sandy mud.

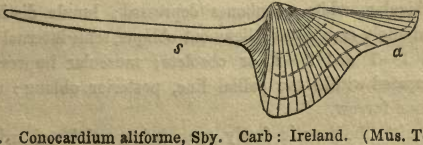

Fig. 214. Conocardium aliforme, Sby. Carb: Ireland. (Mus. Tennant.)

Fossil, 270 sp. U. Silurian —. Patagonia — S. India.

C. Hillanum, Sby. (Protocardium, Beyr.) is the type of a small group in which the sides are concentrically furrowed, the posterior slope radiately striated; the pallial line is slightly sinuated. Jura — Chalk; Europe; India.

CONOCARDIUM, Bronn.

Syn. Lychas, Stein. Pleurorhynchus, Ph. Lunulo-cardium, Münster.

Type, C. Hibernicum, Pl. XIX. fig. 5. C. aliforme, fig. 214.

Shell, equivalve trigonal, conical and gaping in front, truncated behind, with a long siphonal tube near the umbones; anterior slope radiately, posterior obliquely striated; margins strongly crenulated within; hinge with anterior and posterior laminar teeth: ligament external.

The truncated end has usually been considered *anterior,* a conclusion which seems incompatible with the vertical position and burrowing habits of most free and equivalve shells: if compared with *Adacna* (fig. 213) the large gape (*a*) will be for the foot, and the long tube (*s*) siphonal. *C. Hibernicum* has an expanded keel, like *Hemicardium inversum.* The shell-structure is prismatic-cellular, as first pointed out by Sowerby; but the cells are cubical, and much larger than in any of the *Aviculadæ.* In *Cardium* the outer layer is only corrugated or obscurely prismatic-cellular.

Fossil, 30 sp. U. Silurian — Carb. N. America, Europe.

XI.

FAMILY X. LUCINIDÆ.

Shell orbicular, free, closed; hinge-teeth 1 or 2, laterals 1—1 or obsolete; interior dull, obliquely furrowed; pallial line simple; muscular impressions 2, elongated, rugose; ligament inconspicuous or sub-internal.|

Animal with mantle-lobes open below, and having one or two siphonal orifices behind; foot elongated, cylindrical, or strap-shaped (*ligulate*), protruded at the base of the shell; gills one (or two) on each side, large and thick, oval; mouth and palpi usually minute.

The *Lucinidæ* are distributed chiefly in the tropical and temperate seas, upon sandy and muddy bottoms, from the sea-shore to the greatest habitable depths. The shell consists of two distinct layers.

LUCINA, Bruguière.

Etym. Lucina, a name of Juno.

Type, L. Pennsylvanica, Pl. XIX. fig. 6.

Shell orbicular, white; umbones depressed; lunule distinct; margins smooth or minutely crenulated; ligament oblique, semi-internal; hinge-teeth 2.2, laterals 1—1 and 2—2, or obsolete; muscular impressions rugose, anterior elongated within the pallial line, posterior oblong; umbonal area with an oblique furrow.

Animal with the mantle freely open below; siphonal orifices simple;

mouth minute, lips thin; gills single on each side, very large and thick; foot cylindrical, pointed, slightly heeled at the base.

The foot of *Lucina* is often twice as long as the animal, but is usually folded back on itself and concealed between the gills; it is hollow throughout. *L. lactea* (Loripes, Poli.) has a long, contractile anal tube. *L. tigrina* (Codakia, Scop.) has the ligament concealed between the valves, its lateral teeth are obsolete.

Distr. 70 sp. W. Indies, Norway, Black Sea, N. Zealand;—120 fms.

Fossil, 200 sp. U. Silurian —. U. States — T. del. Fuego; Europe — S. India.

Sub-genus, Cryptodon, Turton. L. flexuosa, Pl. XIX. fig. 7. *Syn.* Ptychina, Phil. Thyatira, Leach. Clausina (ferruginosa) Jeffr. *Shell* thin, edentulous; ligament quite internal, oblique, *Animal* with a long anal tube. *Distr.* Norway — N. Zealand. *Fossil,* Eocene —. U. S. Europe.

CORBIS, Cuvier.

Etym. Corbis, a basket. *Type,* C. elegans. Pl. XIX. fig. 8.

Syn. Fimbria, Muhl. not Bohadsch. "Idotæa," Schum.

Shell oval, ventricose, sub-equilateral, concentrically sculptured; margins denticulated within; hinge-teeth 2, laterals 2, in each valve; pallial line simple; umbonal area with an oblique furrow, muscular impressions round and polished; pedal scars close to adductors.

Animal with the mantle open below, doubly fringed; foot long pointed; siphonal opening single, with a long retractile tubular valve; lips narrow; palpi rudimentary; gills single on each side, thick, quadrangular, plaited, united behind.

Distr. 2 sp. India, China, N. Australia, Pacific.

Fossil, 80 sp. (including sub-genera). Lias —. U. States, Europe.

In *C. dubia* (Semi-corbis) Desh. *Eocene,* Paris, the lateral teeth are obsolete.

Sub-genera. Sphæra (corrugata) Sby. *Shell* globular, concentrically furrowed and obscurely radiated; ligament prominent; margins crenulated; hinge-teeth 2.2, obscure; laterals obsolete. *Fossil,* Trias — Chalk. Europe.

? *Unicardium,* D'Orb. (Mactromya, Ag. part) = Corbula cardioïdes, Sby. *Shell* thin, oval, ventricose, concentrically striated; ligamental plates elongated; pallial line simple; hinge with an obscure tooth, or edentulous *Fossil,* 40 sp. ? Lias — Portlandian. Europe.

? TANCREDIA, Lycett, 1850.

Dedicated to Sir Thos. Tancred, Bt. founder of the Cotteswolde Naturalists Club.

Ex. T. extensa, L. Pl. XXI. fig. 22. *Syn.* Hettangia, Turquem.

Shell trigonal, smooth; anterior side usually longest; cardinal teeth

2.2, one of them small; a posterior lateral tooth in each valve; ligament external; muscular impressions oval; pallial line simple.

Fossil, 11 sp. Lias — Bath Oolite. Brit. France.

DIPLODONTA. Bronn.

Etym. Diplos, twin, *odonta*, teeth. *Syn.* Sphærella, Conrad.

Type, D. lupinus (Venus) Brocchi. Pl. XIX. fig. 9.

Shell sub-orbicular, smooth; ligament double, rather long, sub-marginal; hinge-teeth 2.2, of which the anterior in the left valve, and posterior in the right, are bifid; muscular impressions polished, anterior elongated.

Animal with the mantle-margins nearly plain, united; pedal opening large, ventral; foot pointed, hollow; palpi large, free; gills 2 on each side, distinct, the outer oval, inner broadest in front, united behind; branchial orifice small, simple; anal larger, with a plain valve.

Distr. 12 sp. W. Indies, Rio, Brit. Medit. Red Sea, W. Africa, India, Corea, Australia, California. D. diaphana (Felania Recluz) burrows in sand.

Fossil, Eocene —. U. States, Europe.

? *Scacchia*, Philippi, 1844; Tellina elliptica, Sc. *Shell* minute, ovate, posterior side shortest; hinge-teeth 1 or 2, laterals obsolete; ligament minute; cartilage internal, in an oblong pit. *Animal* with mantle widely open; siphonal orifice single; foot compressed, linguiform; palpi moderate, oblong. *Distr.* 2 sp. Medit. *Fossil*, 1 sp. Pliocene, Sicily.

? *Cyamium*, Philippi, 1845, C. antarcticum, Pl. XIX. fig. 16. *Shell* oblong, hinge-teeth 2.2; ligament double; cartilage in a triangular groove behind the teeth in each valve. *Distr.* Patagonia.

UNGULINA, Daudin.

Etym. Ungulina, like a hoof. *Type*, U. oblonga. Pl. XIX. fig. 10.

Shell sub-orbicular; ligament very short; epidermis thick, wrinkled, sometimes black; hinge-teeth 2.2; muscular impressions long, rugose.

Animal with the mantle open below, fringed; siphonal orifice single; foot vermi-form, thickened at the end and perforated, projecting from the base of the shell or folded up between the gills; palpi pointed; gills 2 on each side, unequal, the external narrower, with a free dorsal border, inner widest in front.

Distr. 4 sp. Senegal, Philippines, excavating winding galleries in coral.

KELLIA, Turton, 1822.

Etym. Named after Mr. O'Kelly of Dublin.

Syn. Lasea (Leach) Br. 1827. Cycladina (Adansonii) Cantr. Bornia (sub-orbicularis) *Phil.* Poronia (rubra) Recluz (not Willd.) Erycina (cycladiformis) Desh. (not Lam.)

Types, K. sub-orbicularis. Mont. K. rubra. Pl. XIX. fig. 12.

Shell small, thin, sub-orbicular, closed; beaks small; margins smooth; ligament internal, interrupting the margin (in *K. suborbicularis*), or on the thickened margins (in *K. rubra*); cardinal teeth 1 or 2, laterals 1—1 in each valve.

Animal with the mantle prolonged in front into a respiratory canal, either complete (in *K. suborbicularis*) or opening into the pedal slit (in *K. rubra*); foot strap-shaped, grooved; gills large, two on each side, united posteriorly, the external pair narrower and prolonged dorsally; palpi triangular; posterior siphonal orifice single, exhalent.

The hinges of these little shells are subject to variations, which are not constantly associated with the modifications of the mantle-openings. They creep about freely, and fix themselves by a *byssus* at pleasure. *K. rubra* is found in crevices of rocks at high-water mark, and often in situations only reached by the spray, except at spring-tides; other species range as deep as 200 fms. *K. Laperousii* (Chironia) Desh. Pl. XIX. fig. 11, was obtained, burrowing in sandstone, from deep-water, at Monterey, California.

Distr. 20 sp. Norway — New Zealand — California.

Fossil, 20 sp. Eocene —. U. States, Europe.

Sub-genera. Turtonia (minuta) Hanley. *Shell* oblong, inequilateral, anterior side very short; ligament concealed between the valves; hinge-teeth 2.2. *Animal* with the mantle open in front; foot large, heeled; siphon single, slender, elongated, protruded from the long end of the shell. *Distr.* Greenland, Norway, Brit. In pools and crevices of rocks between tide-marks, and in the roots of sea-weeds and corallines. Mr. Thompson obtained them from the stomachs of mullets taken on the N.E. coast of Ireland.

Pythina (Deshayesiana) Hinds. (Myllita, D'Orb. and Recl.) *Shell* trigonal, divaricately sculptured; ligament internal; right valve with 2 lateral teeth, left with 1 cardinal and 2 laterals. *Distr.* 2 sp. New Ireland, Australia, Philippines. *Fossil,* Eocene —. France.

MONTACUTA, Turton.

Dedicated to Col. George Montagu, the most distinguished of the earlier English malacologists.

Type, M. substriata. Pl. XIX. fig. 13.

Shell minute, thin, oblong, anterior side longest; hinge-line notched; ligament internal, between 2 laminar, diverging teeth (with a minute ossicle. *Lovén*).

Animal with the mantle open in front; margins simple; siphonal orifice single; foot large and broad, grooved.

The *Montacutæ* moor themselves by a byssus, or walk freely; *M. substriata* has only been found attached to the spines of the purple heart-urchin (*Spatangus purpureus*) in 5—90 fms. *M. bidentata* burrows in the valves of dead oyster-shells.

Distr. 3 sp. U. S. Norway, Brit. Ægean. *Fossil,* 2 sp. Miocene —. Brit.

Lepton, Turton.

Etym. Lepton, a minute piece of money (from *leptos*, thin).

Syn. ? Solecardia (eburnea) Conrad, L. California.

Type, L. squamosum. Pl. XIX. fig. 14, Fig. 215.

Shell sub-orbicular, compressed, smooth, or shagreened, a little opened at the ends and longest behind; hinge-teeth 0.1 or 1.1. in front of an angular cartilage notch; lateral teeth 2.2 and 1.1.

Animal with the mantle (*m*) open in front, extending beyond the shell, and bearing a fringe of filaments, of which one in front (*t*) is very large; siphon (*s*) single; gills 2 on each side, separate; foot (*f*) thick, tapering, heeled and grooved, forming a sole or creeping disk. (*Alder.*)

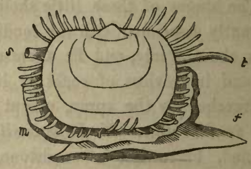

Fig. 215. *Lepton.*

Distr. 3 sp. U. S. Brit. Spain. Laminarian and Coralline Zones.

Fossil, Miocene —. U. S. Brit.

Galeomma, Turton.

Syn. Hiatella, Costa (not Daud.); Parthenopea, Scacchi (not Fabr.)

Type, G. Turtoni, Pl. XIX. fig. 15. (*Galee*, weasel, *omma*, eye.)

Shell thin, oval, equilateral, gaping widely below; invested with a thick, fibrous epidermis; beaks minute; ligament internal; teeth 0.1.

Animal with the mantle-lobes united behind and pierced with 1 siphonal orifice, margins double, the inner with a row of eye-like tubercles; gills large, sub-equal, united behind; lips large, palpi lanceolate, plaited; foot long compressed, with a narrow flat sole.

The *Galeomma* spins a byssus, but breaks from its mooring at will and creeps about like a snail, spreading out its valves nearly flat. (*Clarke.*)

Distr. 3 sp. Brit. Medit. Mauritius, Pacific.

Fossil, Pliocene —. Sicily.

XII. FAMILY XI. Cycladidæ.

Shell sub-orbicular, closed; ligament external; epidermis thick, horny; umbones of aged shells eroded; hinge with cardinal and lateral teeth; pallial line simple, or with a very small inflection.

Animal with mantle open in front, margins plain; siphons (1 or 2) more or less united, orifices usually plain; gills 2 on each side, large unequal, united posteriorly; palpi lanceolate: foot large, tongue-shaped.

All the shells of this family were formerly included in the genus *Cyclas*, a name now retained for the small species inhabiting the rivers of the north temperate zone; the *Cyrenæ* are found in warmer regions, on the shores of creeks and in brackish water, where they are gregarious, burying vertically in the mud, and often associated with members of marine genera.

CYCLAS, Bruguière.

Etym. Kuklas, orbicular. *Type,* C. Cornea. Pl. XIX. fig. 17.

Syn. Sphærium, Scop. Pisum, Muhlf. (not L.) Musculium, Link.

Shell thin, ventricose, nearly equilateral; cardinal teeth 2.1, minute, laterals 1—1 : 2—2, elongated, compressed.

Animal ovo-viviparous; siphons partly united, anal shortest, orifices plain; gills very large, the outer smallest, with a dorsal flap; palpi small and pointed.

The fry of *Cyclas* are hatched in the *internal* branchiæ, they are few in number and very unequal in size; a full-grown *C. cornea* has about 6 in each gill; the largest being $\frac{1}{6}$ to $\frac{1}{4}$ the length of the parent. The young *Cyclades* and *Pisidia* are very active, climbing about submerged plants and often suspending themselves by byssal threads; the striated gills and pulsating heart are easily seen through the shell.

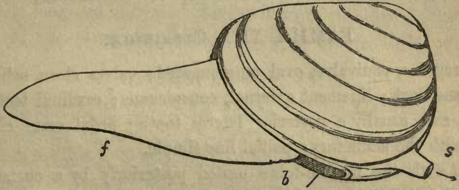

Fig 216. *Pisidium amnicum*, $\frac{3}{1}$. with its foot protruded.

Sub-genus, Pisidium, Pfr. P. amnicum, Pl. XIX. fig. 18. *Shell* inequilateral, anterior side longest; teeth stronger than in *Cyclas. Animal* with a single, small, excurrent siphon; branchial and pedal orifices confluent.

Distr. 30 sp. U. States, S. America, Greenland, Norway, Sicily, Algeria, Cape, India, Caspian.

Fossil, 35 sp. Wealden —. Europe.

CYRENA, Lamarck.

Etym. Cyrene, a nymph. *Type,* C. cyprinoides, Pl. XIX. fig. 20.

Shell oval, strong, covered with thick, rough epidermis; ligament thick and prominent; hinge-teeth 3.3, laterals 1—1 in each valve; pallial line slightly sinuated.

Animal (of type) with the mantle open in front and below, margins plain; siphons short, orifices fringed; gills unequal, square in front, plaited, inner lamina free at base; palpi lanceolate; foot strong, tongue-shaped.

Section, Corbicula, Muhlf. *C. consobrina,* Pl. XIX. fig. 21. *Shell* orbicular, concentrically furrowed, epidermis polished; lateral teeth elongated, striated across.

Distr. 25 sp. Tropical America (eastern); Egypt, India, China, Australia, Pacific Ids. In the mud of rivers, and in mangrove swamps, usually near the coast. *C. consobrina* ranges from Egypt to Cashmere and China, and is found fossil in the Pliocene formations of England,* Belgium and Sicily.

Fossil, 70 sp. Wealden —. Europe, U. States.

? CYRENOIDES, Joannis.

Syn. Cyrenella, Desh. *Type*, C. Dupontii, Pl. XIX. fig. 19.

Shell orbicular, ventricose, thin, eroded at the beaks; epidermis dark olive; ligament external, prominent, elongated; cardinal teeth 3:2, the central tooth of the right valve bifid; muscular impressions long, narrow; pallial line simple.

Animal with the mantle open in front and below, margin simple, siphons short, united; palpi moderate, narrow; gills very unequal, narrow, united behind; foot cylindrical elongated.

Distr. 1 sp. R. Senegal. The marine sp. are *Diplodontæ*.

XIII. FAMILY XII. CYPRINIDÆ.

Shell regular, equivalve, oval or elongated; valves close, solid; epidermis thick and dark; ligament external, conspicuous; cardinal teeth 1—3 in each valve, and usually a posterior lateral tooth; pedal scars close to, or confluent with the adductors; pallial line simple.

Animal with the mantle-lobes united posteriorly by a curtain, pierced with two siphonal orifices; foot thick, tongue-shaped; gills 2 on each side, large, unequal, united behind, forming a complete partition; palpi moderate, lanceolate.

One half the genera of this family are extinct, and the rest (excepting *Circe*) were more abundant in former periods than at the present time. *Cyprina* and *Astarte* are boreal forms; *Circe and Cardita* abound in the Southern seas.

CYPRINA, Lamarck.

Etym. Kuprinos (from *Kupris*) related to Venus.

Type, C. Islandica, Pl. XIX. fig. 22. *Syn.* Arctica, Schum.

Shell oval, large and strong, with usually an oblique line or angle on the posterior side of each valve; epidermis thick and dark; ligament prominent; umbones oblique; no lunule; cardinal teeth 2:2, laterals 0—1, 1—0; muscular impressions oval, polished; pallial sinus obsolete.

Animal with the mantle open in front and below, margins plain; siphonal orifices close together, fringed, slightly projecting; outer gills semilunar, inner truncated in front.

The principal hinge-tooth in the right valve of *Cyprina* represents the second and third in *Venus* and Cytherea; the second tooth of the left valve is consequently obsolete.

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* Associated with the bones of *Elephas meridionalis, Rhinoceros leptorhinus, Mastodon Arvernensis, Hippopotamus major*, &c.

Distr. *C. Islandica* ranges from Greenland and the U. S. to the Icy Sea, Norway, and England; in 5—80 fm. water. It occurs fossil in Sicily and Piedmont, but not alive in the Medit.

Fossil, 90 sp. (D'Orb.) Muschelkalk —. Europe.

CIRCE, Schumacher.

Etym. In Greek myth. a celebrated enchantress.

Ex. C. corrugata, Pl. XX. fig. 2. *Syn.* Paphia (undulata) Lam.*

Shell sub-orbicular, compressed, thick, often sculptured with diverging striæ; umbones flat; lunule distinct; ligament nearly concealed; margins smooth; hinge-teeth 3:3; laterals obscure; pallial line entire.

Animal (of *C. minima*) with the mantle open, margins denticulate, siphonal orifices close together, scarcely projecting, fringed; foot large, heeled; palpi long and narrow. Ranges from 8—50 fms. (Forbes.)

Distr. 37 sp. Australia, India, Red Sea, Canaries, Brit.

ASTARTE, Sowerby, 1816.

Syn. Crassina, Lam. Tridonta, Schum. Goodallia, Turton.

Ex. A. sulcata, Pl. XX. fig. 1. (*Astarte*, the Syrian Venus.)

Shell sub-orbicular, compressed, thick, smooth or concentrically furrowed; lunule impressed; ligament external; epidermis dark: hinge-teeth 2:2, the anterior tooth of the right valve large and thick; anterior pedal scar distinct; pallial line simple.

Animal with mantle open; margins plain or slightly fringed; siphonal orifices simple; foot moderate, tongue-shaped; lips large, palpi lanceolate; gills nearly equal, united behind, and attached to the siphonal band.

Distr. 14 sp. Behrings Sea, Wellington Channel, Kara Sea, Ochotsk, U. S. Norway, Brit. Canaries, Ægean (30—112 fms.)

Fossil, 200 sp. (D'Orb.) Lias —. N. and S. America, Europe, Thibet.

? *Digitaria*, Wood; Tellina digitaria, L. Medit. *Fossil*, Crag, Brit.

CRASSATELLA, Lamarck.

Syn. Ptychomya, Ag. Paphia (Lam. part) Roissy.

Type, C. ponderosa, Pl. XXI. fig. 4. *Etym.* *Crassus* thick.

Shell solid, ventricose, attenuated behind, smooth or concentrically furrowed; lunule distinct; ligament internal; margin smooth or denticulated;

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* This name was employed by Bolten, in 1798, for sp. of *Veneridæ*, and by Lamarck, in 1801, for *Venus divaricata*, Chemn. (= Circe divaricata *and* Crassatella contraria) and *Mesodesma glabratum*. In 1808, Fabricius adopted the name for a group of butterflies, in which sense it is now widely employed, having been abandoned by Lamarck in his later works, and by all succeeding malacologists.

pallial line simple; hinge-teeth 1:2, striated, in front of cartilage pit; lateral teeth 0—1, 1—0; adductor impressions deep, rounded; pedal small, distinct.

Animal with mantle-lobes united only by the branchial septum; inhalent margins cirrated; foot moderate, compressed, triangular grooved; gills smooth, unequal, outer semi-lunar, inner widest in front; palpi triangular.

Distr. 30 sp. Australia, N. Zealand, Philippines, India, W. Africa, Canaries, Brazil.

Fossil, 50 sp. Neocomian —. Patagonia, U. S. Europe.

ISOCARDIA, Lam. Heart-cockle.

Etym. Isos, like, *cardia*, the heart. *Type*, I. cor. Pl. XX. fig. 3.

Syn. Glossus, Poli; Bucardium, Muhlfeldt; Pecchiolia, Meneghini.

Shell cordate, ventricose; umbones distant, sub-spiral; ligament external; hinge-teeth 2:2; laterals 1—1 in each valve, the anterior sometimes obsolete.

Animal with the mantle open in front; foot triangular, pointed, compressed; siphonal orifices close together, fringed; palpi long and narrow; gills very large, nearly equal.

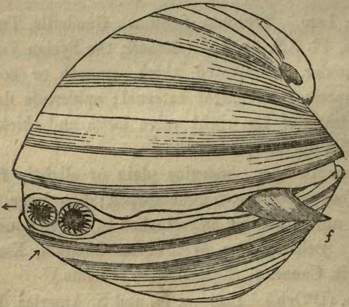

Fig. 217. Isocardia cor.

The heart-cockle burrows in sand, by means of its foot (*f*), leaving only the siphonal openings exposed. (*Bulwer.*)

Distr. 5 sp. Brit. Medit. China, Japan.

Fossil, 70 sp. Trias —. U. S. Europe, S. India.

The Isocardia-shaped fossils of the old rocks belong to the genera *Cardiomorpha* and *Iso-arca;* many of those in the Oolites to *Ceromya.* Casts of true *Isocardiæ* have only two transverse dental folds between the beaks, and no longitudinal furrows.

CYPRICARDIA, Lam.

Ex. C. obesa, Pl. XX. fig. 4. *Syn.* Trapezium, Humph. Libitina, Sch.

Shell oblong, with an oblique posterior ridge; umbones anterior depressed; ligament external, in deep and narrow grooves; cardinal teeth 2:2, laterals 1—1 in each valve, sometimes obscure; muscular impressions oval, (of two elements); pallial line simple.

Animal (of *C. solenoides*) with mantle-lobes united, cirrated behind; pedal opening moderate; foot small, compressed, with a large byssal pore near the heel; siphons short, conical, unequal, cirrated externally; orifices fringed; palpi small; gills unequal, the outer narrower and shorter, deeply lamellated, united posteriorly, the inner prolonged between the palpi.

Distr. 13 sp. Red Sea, India, Australia. In crevices of rock and coral.

Fossil, 60 sp. L. Silurian —. N. America, Europe.

? *Sub-genera. Coralliophaga,* Bl. C. coralliophaga, Lam. *Shell* long, cylindrical, thin, slightly gaping behind; hinge-teeth 2:2, and a laminar posterior tooth; pallial line with a wide and shallow sinus. *Distr.* 2 sp. Medit. in the burrows of the *Lithodomus;* sometimes two or three dead shells are found one within the other, besides the original owner of the cell.

? *Cypricardites,* Conrad (part). An. Geol. Rep. 1841. (Sanguinolites, M'Coy). Employed for Cypricardia-shaped shells of the palæozoic rocks; some of them are more nearly related to *Modiola* (v. Modiolopsis, p. 266) but they bear no resemblance to *Sanguinolaria.*

Pleurophorus, King, 1848.

Type, P. costatus, Brown. Permian, England, (Pal. Trans. 1850. Pl. XV. fig. 13—20.)

Syn. ? Cleidophorus, Hall (cast only). Unionites, Wissm. ? Mæonia, Dana.

Shell oblong; dorsal area defined by a line, or keel; umbones anterior, depressed; hinge-teeth 2.2; laterals 1.1; elongated posterior; anterior adductor impression deep, with a small pedal scar close to it, and bounded posteriorly by a strong rib from the hinge; pallial line simple.

Fossil, L. Silurian — Trias. U. States; Europe, N. S. Wales, Tasmania.

? Cardilia, Deshayes.

Type, C. semisulcata, Pl. XVIII. fig. 18. *Syn.* Hemicyclonosta, Desh.

Shell oblong, ventricose, cordate; beaks prominent, sub-spiral; hinge with a small tooth and dental pit in each valve; ligament partly internal contained in a spoon-shaped inflection; anterior muscular scar long, with a pedal scar above; posterior adductor impression on a prominent sub-spiral plate; pallial line simple.

Distr. 2 sp. Chinese Sea; Moluccas.

Fossil, 2 sp. Eocene —. France, Piedmont.

Megalodon, J. Sowerby.

Type, M. cucullatus, Pl. XIX. fig. 19. (*Megas,* large, *odous,* tooth.)

Shell oblong, smooth or keeled; ligament external; hinge-teeth 1:2, thick;

laterals 1.1, posterior; anterior adductor impression deep, with a raised margin; and a small pedal scar behind it.

In the typical species the beaks are sub-spiral, the lateral teeth obscure, and the posterior adductors bounded by prominent ridges.

Fossil, 14 sp. U. Silurian — Devonian; U. States, Europe.

Sub-genera. ? *Goldfussia* (nautiloides) Castlenau. Umbones spiral; anterior side concentrically furrowed; posterior side with two oblique ridges. *Fossil,* Silurian, U. States.

Megaloma (Canadensis) Hall, 1852. U. Silurian, Canada. Umbones very thick, hinge-teeth rugged, almost obliterated with age; posterior lateral teeth 1.1; no muscular ridges.

PACHYDOMUS (Morris) J. Sowerby.

Etym. Pachus, thick, *domos,* house. *Syn.* Astartila, Dana.

? Cleobis (grandis) Dana. ? Pyramus (ellipticus) D. = Notomya, M'Coy.

Type, P. globosus (Megadesmus) J. Sby. in Mitchell's Australia.

Shell oval, ventricose, very thick; ligament large, external; lunette more or less distinct; hinge-line sunk; teeth 1 or 2 (?) in each valve; adductor impressions deep; anterior pedal scar distinct; pallial line broad and simple, or with a very shallow sinus.

Fossil, 5 sp. Devonian ? N. S. Wales, Tasmania.

PACHYRISMA, Morris and Lycett.

Etym. Pachus, thick, *ereisma,* support.

Type, P. grande, M. and L. Great Oolite (Bathonian) Minchinhampton.

Shell cordate, with large sub-spiral beaks; valves very thick near the umbones, obliquely keeled; hinge with one thick conical tooth (behind the dental pit, in the right valve), a small lateral tooth close to the deep and oval anterior adductor, and a posterior lateral-tooth (or muscular lamina ?); ligamental plates short and deep.

OPIS, Defrance.

Ex. O. lunulata, Pl. XIX. fig. 24. (*Opis,* a name of Artemis.)

Shell strong, ventricose, cordiform, obliquely keeled; beaks prominent, incurved or sub-spiral; cardinal teeth 1.1; lunule distinct.

Fossil, 42 sp. Trias — Chalk. Europe.

CARDINIA, Agassiz.

Etym. Cardo-inis, a hinge. *Type,* C. Listeri, Pl. XIX. fig. 23.

Syn. Thalassides, Berger 1833 (no descr.) Sinemuria, Christol. Pachyodon, Stutch. (not Meyer nor Schum.) Pronoe, Ag.

Shell oval or oblong, attenuated posteriorly, compressed, strong, not pearly, marked by lines of growth; ligament external; cardinal teeth obscure, laterals 1—0, 0—1, remote, prominent; adductor impressions deep pallial line simple.

Fossil, 20 sp. Lias —. Inf. Oolite, Europe; along with *marine* shells.

Sub-genus ? *Anthracosia,* King, 1844; Unio sub-constrictus. Sby. U. Sil. — Carb. 40 sp. They occur in the valuable layers of clay-ironstone called "mussel-bands," associated with *Nautili, Discinæ,* &c. In Derbyshire the mussel-band is wrought, like marble, into vases.

? MYOCONCHA, J. Sowerby.

Type, M. crassa, Pl. XIX. fig. 25. (*Mya,* mussel, *concha,* shell.)

Shell oblong, thick, with nearly terminal depressed umbones; ligament external, supported by long narrow appressed plates; hinge thick, with an oblique tooth in the right valve; anterior muscular impression round and deep, with a small pedal scar behind it; posterior impression large, single; pallial line simple.

This shell, which is not nacreous inside, is distinguished from any of the *Mytilidæ* by the form of its ligamental plates and muscular impressions; the hinge-tooth is usually overgrown and nearly obliterated by the hinge-margin as in aged examples of *Cardita orbicularis* and *Cypricardia vellicata.*

Fossil, 26 sp. Permian — Miocene. (D'Orb.) Europe.

Sub-genus. ? *Hippopodium* (ponderosum, Sby.) Coneybeare. Lias, Europe. *Shell* oblong, thick, ventricose; umbones large; ligament external; ventral margin sinuated; hinge with one thick, oblique tooth in each valve, sometimes nearly obsolete; pallial line simple; anterior muscular scar deep. This shell appears to be a ponderous form of *Cypricardia* or *Cardita;* it is a characteristic fossil of the English Lias, but only very aged examples have been found.

CARDITA, Bruguière.

Syn. Mytilicardia and Cardiocardita, (ajar) Bl. Arcinella, Oken.

Type, C. calyculata, Pl. XX. fig. 5. *Etym. Cardia,* the heart.

Shell oblong, radiately ribbed; ligament external; margins toothed; hinge-teeth 1:2, and an elongated posterior tooth; pallial line simple; anterior pedal scar close to adductor.

Animal with the mantle lobes free, except between the siphonal orifices; branchial margin with conspicuous cirri; foot rounded and grooved, spinning a byssus; labial palpi short, triangular, plaited; gills rounded in front, tapering behind and united together, the outer pair narrowest.

C. pectunculus, Brug. (*Mytilicardia,* Bl.) has an anterior tooth. *C. concamerata,* Brug. found at the Cape, has a remarkable cup-like inflection of the ventral margin of each valve.

Sub-genus. Venericardia, Lam. V. ajar, Pl. XX. fig. 6. *Shell* cordate, ventricose; hinge without lateral teeth. *Animal* locomotive, with a sickle-shaped foot like the cockles.

Distr. 50 sp. Chiefly in tropical seas, on rocky bottoms and in shallow water; the *Venericardiæ* on coarse sand and sandy mud. W. Indies, U. S. W. Africa, Medit. Red Sea, India, China, Australia, New Zealand, Pacific, W. America. *C. borealis*, Conrad, inhabits the sea of Ochotsk; *C. abyssicola*, Hinds, ranges to 100 fms.; *C. squamosa*, to 150 fms.

Fossil, 100 sp. Trias —. U. S. Patagonia, Europe, S. India.

? VERTICORDIA, Searles Wood, 1844.

Syn. Hippagus, Philippi, not Lea. (*Verticordia*, a name of Venus.)

Type, V. cardiiformis (Wood, in Sby. Min. Con.) Pl. XVII. fig. 26.

Shell sub-orbicular, with radiating ribs; beaks sub-spiral; margins denticulated; interior brilliantly pearly; right valve with 1 prominent cardinal tooth; adductor scars 2, faint; pallial line simple; ligament internal, oblique; epidermis dark brown.

Distr. 2 sp. China Sea (Adams). Medit. ? (Forbes.)

Fossil, 2 sp. Miocene —. Brit. Sicily.

Hippagus isocardioides, Lea, 1833, Eocene, Alabama: is edentulous.

SECTION *b*. SINU-PALLIALIA.

Respiratory siphons long; pallial line sinuated.

FAMILY XIV. VENERIDÆ.

Shell regular, closed, sub-orbicular or oblong; ligament external; hinge with usually 3 diverging teeth in each valve; muscular impressions oval, polished; pallial line sinuated.

Animal free, locomotive, rarely byssiferous or burrowing; mantle with a rather large anterior opening; siphons unequal, united more or less; foot linguiform, compressed, sometimes grooved; palpi moderate, triangular, pointed; branchiæ large, sub-quadrate, united posteriorly.

The shells of this tribe are remarkable for the elegance of their forms and colours; they are frequently ornamented with chevron-shaped lines. Their texture is very hard, all traces of structure being usually obliterated. The *Veneridæ* appeared first in the Oolitic period, and have attained their greatest development at the present time; they are found in all seas, but most abundantly in the tropics.

VENUS, L.

Syn. Merceneria, Antigone and Anomalocardia (flexuosa) Schum. Chione, Megerle (not Scop,) Erycina (cardioides) Lam. 1818.

Type, V. paphia, L. Pl. XX. fig. 7.

Shell thick, ovate, smooth, sulcated or cancellated; margins minutely crenulated; cardinal teeth 3—3; pallial sinus small, angular; ligament prominent; lunule distinct.

Animal with mantle-margins fringed; siphons unequal, more or less separate; branchial orifice sometimes doubly fringed, the outer pinnate; anal orifice with a simple fringe and tubular valve; foot tongue-shaped; palpi small, lanceolate.

V. textilis, and other elongated species, have a deep pallial sinus; *V. gemma* (Totten) has a very deep angular sinus, like *Artemis; V. reticulata* has bifid teeth, like *Tapes; V. tridacnoides*, a fossil of the U. States, has massive valves, ribbed like the clam-shell. The N. American Indians used to make coinage (*wampum*) of the sea-worn fragments of *Venus mercenaria*, by perforating and stringing them on leather thongs.

Distr. 176 sp. World-wide. Low-water — 140 fathoms. *V. astartoides*, Behrings' Sea. *V. verrucosa*, Brit. Medit. Senegal, Cape, Red Sea; Australia ?

Fossil, 160 sp. Oolites —. Patagonia, U. S. Europe, India.

? *Volupia rugosa*, (Defrance, 1829.) Shell minute, Isocardia-shaped, concentrically ribbed, with a large lunule. *Eocene*, Hauteville.

Saxidomus (Nuttalli) Conrad. Oval, solid, with tumid umbones; lunule, 0; teeth 3—4, unequal, the central bifid; pallial sinus large. *Distr.* 8 sp. India, Australia, W. America.

CYTHEREA, Lam.

Etym. Cytherea, from Cythera, an Aegean Island.

Syn. Meretrix, Gray. Dione, Megerle.

Examples, C. dione, Pl. XX. fig. 8. C. chione, fig. 14, p. 26.

Shell like *Venus*; margins simple; hinge with 3 cardinal teeth and an anterior tooth beneath the lunule; pallial sinus moderate, angular.

Animal with plain mantle-margins; siphons united half-way.

Distr. Same as *Venus*. Recent 113 sp. *Fossil*, 80 sp.

MEROE, Schum.

Etym. Meroë, an island of the Nile.

Syn. Cuneus (part) Megerle (not Da Costa). Sunetta, Link.

Type, M. picta (= Venus Meroë, L. Donax, Desh.) Pl. XX. fig. 9.

Shell oval, compressed; anterior side rather longest; hinge with 3 cardinal teeth, and a long narrow anterior tooth; lunule lanceolate; ligament in a deep escutcheon.

Distr. 10 sp. Senegal, India, Japan, Australia.

TRIGONA, Mühlfeldt.

Etym. Trigonos, theee-cornered. *Type*, T. tripla, Pl. XX. fig. 10.

Shell trigonal, wedge-shaped, sub-equilateral; ligament short, prominent; cardinal teeth 3—4, anterior $\frac{2}{1}$ remote; pallial sinus rounded, horizontal.

Distr. 28 sp. W. Indies, Medit, Senegal, Cape, India, W. America.

Fossil, Miocene —. Bordeaux.

T. crassatelloides attains a diameter of 5 inches and is very ponderous.

Sub-genus, Grateloupia, Desm. G. irregularis, Pl. XX. fig. 11.

Shell sub-equilateral, rounded in front, attenuated behind; hinge with 1 anterior tooth, 3 cardinal teeth and several small posterior teeth; pallial sinus deep, oblique. *Fossil,* 4 sp. Eocene — Miocene. U. States, France.

ARTEMIS, Poli.

Etym. Artemis, in Greek myth. Diana.

Type, A. exoleta, Pl. XX. fig. 12. (*Syn.* Dosinia, Scopoli.)

Shell orbicular, compressed, concentrically striated, pale; ligament sunk; lunule deep; hinge like *Cytherea;* margins even; pallial sinus deep, angular, ascending.

Animal with a large hatchet-shaped foot, projecting from the ventral margin of the shell; mantle-margins slightly plaited; siphons united to their ends; orifices simple; palpi narrow.

Distr. 85 sp. Boreal — Tropical seas; low-water—80 fms.

Fossil, 8 sp. Miocene —. U. States, Europe, S. India.

Sub-genera. Cyclina, Desh. V. Sinensis, Chemn. Orbicular, ventricose, margins crenulated, no lunule, sinus deep and angular. *Distr.* 10 sp. Senegal, India, China, Japan. W. America. *Fossil,* 1 sp. *Miocene,* Bordeaux.

Clementia (papyracea) Gray. Thin, oval, white; ligament semi-internal; posterior teeth bifid, sinus deep and angular. *Animal* with long, united siphons, and a large crescentic foot, similar to *Artemis. Distr.* 3 sp. Australia, Philippines.

LUCINOPSIS, Forbes.

Syn. Dosinia, Gray, 1847 (not Scop.) Mysia, Gray, 1851 (not Leach). Cyclina, Gray, 1853 (not Desh.)

Type, Venus undata, Pennant, Pl. XX. fig. 13. (*Lucina,* and *opsis,* like.)

Shell lenticular, rather thin; right valve with 2 laminar, diverging teeth, left with 3 teeth, the central bifid: muscular impressions oval, polished; pallial sinus very deep, ascending.

Animal with mantle-margins plain; pedal opening contracted; foot pointed, basal; siphons longer than the shell, separate, divergent, with fringed orifices. (Clark.)

Distr. 1 sp. Norway, Brit. *Fossil,* 3 sp. Miocene. Brit. Belgium.

TAPES, Mühlfeldt.

Syn. Paphia, Bolten, 1798. Pullastra, G. Sby.

Example, T. pullastra, Pl. XX. fig. 14. (*Tapes,* tapestry.)

Shell oblong, umbones anterior, margins smooth; teeth 3 in each valve, more or less bifid; pallial sinus deep, rounded.

Animal spinning a byssus; foot thick, lanceolate, grooved; mantle plain or finely fringed; freely open in front; siphons moderate, separate half-way or throughout, orifices fringed, anal cirri simple, branchial ramose; palpi long, triangular.

Distr. 78 sp. Norway, Brit. Black Sea, Senegal, Brazil, India, China, New Zealand. Low-water—100 fms. (Beechey).

Fossil, Miocene —. Brit. France, Belgium, Italy.

The animal is eaten on the continental coasts; it buries in the sand at low-water or hides in the crevices of rocks, and roots of sea-weed.

VENERUPIS, Lamarck.

Etym. Venus, and *rupes*, a rock. *Syn. Gastrana*, Schum.

Example, V. exotica, Pl. XX. fig. 15.

Shell oblong, a little gaping posteriorly, radiately striated and ornamented with concentric lamellæ; three small teeth in each valve, one of them bifid; pallial sinus moderately deep, angular.

Animal with the mantle closed in front, pedal opening moderate; siphons united half-way, anal with a simple fringe and tubular valve, branchial siphon doubly fringed, inner cirri branching; palpi small and pointed.

Distr. 19 sp. Brit. — Crimea; Canaries; India, Tasmania; Kamtschatka. Behring's Sea — Peru. In crevices of rocks.

Fossil, Miocene —. U. States, Europe.

PETRICOLA, Lamarck.

Etym. Petra, stone, *colo*, to inhabit.

Syn. Rupellaria, Bellevue; Choristodon, Jonas; Naranio, Gray.

Type, P. lithophaga, Pl. XX. fig. 16. P. pholadiformis, Pl. XX. fig. 17.

Shell oval or elongated, thin, tumid, anterior side short; hinge with 3 teeth in each valve, the external often obsolete; pallial sinus deep.

Animal with the mantle closed in front, much thickened and recurved over the edges of the shell; pedal opening small; foot small, pointed, lanceolate; siphons partially separate, orifices fringed, anal with a valve and simple cirri, branchial cirri pinnate; palpi small, triangular.

Distr. 30 sp. U. S. France, Red Sea, India, New Zealand, Pacific, W. America (Sitka—Peru). Burrows in limestone and mud.

Fossil, 12 sp. Eocene —. U. S. Europe.

GLAUCOMYA, (Bronn) Gray.

Syn. Glauconome, Gray 1829 (not Goldfuss 1826).

Type, G. Sinensis, Pl. XX. fig. 18. (*Glaucos* sea-green, *mya* mussel.)

Shell oblong, thin; epidermis dark, greenish; ligament external; hinge with 3 teeth in each valve, one of them bifid; pallial sinus very deep and angular.

Animal with a rather small, linguiform foot; pedal opening moderate;

siphons very long, united, projecting far into the branchial cavity when retracted, their ends separate and diverging; palpi large, sickle-shaped; gills long, rounded in front, the outer shortest.

Distr. 11 sp. Embouchures of rivers; China, Philippines, Borneo, India.

FAMILY XV. Mactridæ.

Shell equivalve, trigonal, close, or slightly gaping; ligament (cartilage) internal, contained in a deep triangular pit; epidermis thick; hinge with 2 diverging cardinal teeth, and usually with anterior and posterior laterals; pallial sinus short, rounded.

Animal with the mantle more or less open in front; siphonal tubes united, orifices fringed; foot compressed; gills not prolonged into the branchial siphon.

Sections of the shell exhibit an indistinct cellular layer on the external surface and a distinct inner layer of elongated cells. (*Carpenter.*)

Mactra, L.

Etym. *Mactra,* a kneading trough. *Syn.* Trigonella, Da Costa (not L.) Schizodesma (Spengleri), Spisula (solida), Mulinia (lateralis) Gray.

Type, M. stultorum, Pl. XXI. fig. 1.

Shell nearly equilateral; anterior hinge tooth Λ-shaped, with sometimes a small laminar tooth close to it; lateral teeth doubled in the right valve.

Animal with the mantle open as far as the siphons, its margins fringed; siphons united, fringed with simple cirri, anal orifice with a tubular valve; foot large, linguiform, heeled; palpi triangular, long and pointed; outer gills shortest.

The Mactras inhabit sandy coasts, where they bury just beneath the surface; the foot can be stretched out considerably, and moved about like a finger, it is also used for leaping. They are eaten by the star-fishes and whelks, and in the I. of Arran *M. subtruncata* is collected at low-water to feed pigs. (*Alder.*)

Distr. 60 sp. All seas, especially within the tropics; — 35 fms.

Fossil, 30 sp. Lias —. U. States, Europe, India.

? *Sub-genus.* *Sowerbya,* D'Orb. S. crassa, Oxfordian, France. Cartilage-pit simply grooved; lateral teeth very large.

Gnathodon, Gray.

Etym. *Gnathos* a jaw-bone, *odous* a tooth. *Syn.* Rangia, Desm.

Type, G. cuneatus, Pl. XXI. fig. 2.

Shell oval, ventricose; valves thick, smooth, eroded; epidermis olive; cartilage-pit central; hinge teeth $\frac{2}{1}$; laterals doubled in the right valve, elongated, striated transversely; pallial sinus moderate.

Animal with the mantle freely open in front; margins plain; siphons short, partly united; foot very thick, tongue-shaped, pointed; gills unequal, the outer short and narrow; palpi large, triangular, pointed.

Distr. 1 sp. N. Orleans (3 other sp. ? Mazatlan, California; Moreton B. Australia. *Petit.*)

Fossil, 1 sp. Miocene —. Petersburg, Virginia.

G. cuneatus was formerly eaten by the Indians. At Mobile, on the Gulf of Mexico, it is found in colonies along with *Cyrena Carolinensis,* burying 2 inches deep in banks of mud; the water is only brackish, though there is a tide of 3 feet. Banks of dead shells, 3 or 4 feet thick, are found 20 miles inland: Mobile is built on one of these shell-banks. The road from New Orleans to Lake Pont-chartrain (6 miles) is made of Gnathodon shells procured from the east end of the lake, where there is a mound of them a mile long, 15 feet high, and 20—60 yards wide; in some places it is 20 feet above the level of the lake. (*Lyell.*)

LUTRARIA, Lamarck. Otter's-shell.

Type, L. oblonga, Gmel. Pl. XXI. fig. 3. (= L. solenoides, Lam.)

Shell oblong, gaping at both ends; cartilage-plate prominent, with 1 or 2 small teeth in front of it, in each valve; pallial sinus deep, horizontal.

Animal with closed mantle-lobes; pedal opening moderate; foot rather large, compressed; siphons united, elongated, invested with epidermis; palpi rather narrow, their margins plain; gills tapering to the mouth.

Distr. 18 sp. U. States, Brazil, Brit. Medit. Senegal, Cape, India, N. Zealand, Sitka.

Fossil, 10 sp. Miocene — U. States, Europe.

Resembles *Mya;* burying vertically in sand or mud, especially of estuaries; low-water, 12 fms. *L. rugosa* is found living on the coasts of Portugal and Mogador, fossil on the coast of Sussex. (Dixon.)

ANATINELLA, G. Sowerby.

Type, A. candida, (Mya) Chemn. Pl. XXIII. fig. 6.

Shell ovate, rounded in front, attenuated and truncated behind; cartilage in a prominent spoon-shaped process, with 2 small teeth in front; muscular impressions irregular, the anterior elongated; pallial line slightly truncated behind.

Distr. 3 sp. Ceylon, Philippines; sands at low-water.

FAMILY XVI. TELLINIDÆ.

Shell free, compressed, usually closed and equivalve; cardinal teeth 2 at most, laterals 1—1, sometimes obsolete; muscular impressions rounded, polished; pallial sinus very large; ligament on shortest side of the shell, sometimes internal. Structure obscurely prismatic-cellular; prisms fusiform, nearly parallel with surface, radiating from the hinge in the outer layer, transverse in the inner.

Animal with the mantle widely open in front, its margins fringed; foot tongue-shaped, compressed; siphons separate, very long and slender; palpi large, triangular; gills united posteriorly, unequal, the outer pair sometimes directed dorsally.

The Tellens are found in all seas, chiefly in the littoral and laminarian zones; they frequent sandy bottoms, or sandy mud, burying beneath the surface; a few species inhabit estuaries and rivers. Their valves are often richly coloured and ornamented with finely sculptured lines.

TELLINA, L. Tellen.

Etym. Telline, the Greek name for a kind of mussel.

Syn. Peronæa (*part*) Poli. Phylloda (foliacea), Omala (planata) Schum. Psammotea (solidula) Turt. Arcopagia (crassa) Leach.

Examples, T. lingua-felis, Pl. XXI. fig. 5. T. carnaria, fig. 6.

Shell slightly inequivalve, compressed, rounded in front, angular and slightly folded posteriorly, umbones sub-central; teeth 2.2, laterals 1—1, most distinct in the right valve; pallial sinus very wide and deep; ligament external, prominent.

Animal with slender, diverging siphons, twice as long as the shell, their orifices plain; foot broad, pointed, compressed; palpi very large, triangular; gills small, soft and very minutely striated, the outer rudimental and directed dorsally.

Tellinides, Lam. T. planissima, Pl. XXI. fig. 7. Valves with no posterior fold; lateral teeth wanting.

T. carnaria (*Strigilla,* Turt.) has the valves obliquely sculptured; *T. fabula,* Gron. has the right valve striated, the other plain. *T. Burneti,* California, has the right valve flat; *T. lunulata, Pliocene,* S. Carolina, much resembling it in shape, has the left valve flat.

Distr. above 200 sp. In all seas, especially the Indian Ocean; most abundant and highly coloured in the tropics. Low-water — Coral zone, 50 fms. Wellington Channel; Kara Sea; Behrings' Sea; Baltic; Black Sea.

Fossil, 130 sp. Oolites —. U. States, S. America (Chiloe) Europe.

DIODONTA, Schumacher.

Etym. Di- two, *odonta* teeth. *Syn.* Fragilia, Desh.

Type, Tellina fragilis, L. Pl. XXI. fig. 8.

Shell equivalve, convex, with squamose lines of growth; cardinal teeth 2 in right valve, 1 bifid tooth in left; pallial sinus deep and rounded; umbonal area punctate; ligament external.

Animal with the mantle open in front, its margins fringed; siphons elongated, slender, separate, unequal, orifices with cirri; foot small, compressed, linguiform; palpi large, triangular; gills unequal, soft, finely striated.

Diodonta inhabits shallow water, boring in mud and clay, and not travelling about like the *Tellens.*

Distr. 3 sp. Greenland, Brit. Medit. Black Sea, Senegal, Cape.

Fossil, Miocene —. Brit. France, Belgium.

CAPSULA, Schumacher.

Etym. Dimin. of *capsa,* a box.

Syn. Capsa (part) Brug. 1791. Sanguinolaria Lam. 1818, not 1801.

Type. C. rugosa, Pl. XX. fig. 19. (= Venus deflorata, Gmel.)

Shell oblong, ventricose, slightly gaping at each end; radiately striated; cardinal teeth 2 in each valve, one of them bifid; ligament external, large, prominent; siphonal inflection short.

Animal like *Psammobia;* foot moderate; gills deeply plaited, attenuated in front, outer small, dorsal border wide, fixed; siphons moderate.

Distr. W. Indies, Red Sea, India, China, Australia.

Fossil 4 sp. U. Green-sand —. U. States, Europe. (D'Orb.)

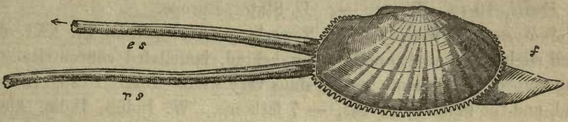

Fig. 218. *Psammobia vespertina,* Chemn, $\frac{1}{2}$, Brit.

PSAMMOBIA, Lamarck. Sunset-shell.

Etym. Psammos sand, *bio* to live.

Syn. Psammotea (zonalis) Lam. Psammocola, Bl. Gari, Schum.

Ex. P. Ferroënsis, Pl. XXI. fig. 9. P. squamosa, Pl. XXI. fig. 10.

Shell oblong, compressed, slightly gaping at both ends; hinge-teeth $\frac{2}{1}$; ligament external, prominent; siphonal inflection deep, in contact with the pallial line; epidermis often dark.

Animal: mantle open, fringed; siphons very long, slender, nearly equal, longitudinally ciliated, orifices with 6—8 cirri; foot large, tongue-shaped; palpi long, tapering; gills unequal, recumbent, few plaited.

Distr. 40 sp. Norway, Brit. India, New Zealand, Pacific. Littoral — coralline zone, 100 fms. *P. gari* is eaten in India.

Fossil, 24 sp. Oolite? Eocene —. U. States, Europe.

SANGUINOLARIA, Lamarck.

Name, from the type, *Solen sanguinolentus,* Chemn.

Syn. Soletellina (*diphos*) Bl. Lobaria, Schum. Aulus, Oken.

Ex. S. livida, Pl. XXII. fig. 1. S. diphos, fig. 2, S. orbiculata, fig. 3.

Shell oval, compressed, rounded in front, attenuated and slightly gaping behind; hinge-teeth $\frac{2}{2}$, small; siphonal inflection very deep, connected with the pallial line; ligament external, on very prominent fulcra.

Animal: mantle open, fringed; siphons very long, branchial largest orifices fringed; foot large, broadly tongue-shaped, compressed; palpi long pointed; gills recumbent, inner laminæ free, dorsal border wide.

Distr. 20 sp. W. Indies, Red Sea, India, Madagascar, Japan; Australia, Tasmania, Peru.

Fossil, 30 sp. Eocene —. U. States, Europe.

SÉMELE, Schumacher, 1817.

Etym. Semele, in Greek myth. the mother of Bacchus.

Syn. Amphidesma, Lam. 1818.* *Type,* S. reticulata, Pl. XXI. fig. 11.

Shell rounded, sub-equilateral, beaks turned forwards; posterior side slightly folded; hinge-teeth 2.2, laterals elongated, distinct in the right valve; external ligament short, cartilage internal, long, oblique; pallial sinus deep, rounded.

Distr. 40 sp. W. Indies, Brazil, India, China, Australia, Peru.

Fossil, 10 sp. Eocene —. U. States, Europe.

Sub-genera. Cumingia, G. Sowerby. C. lamellosa, Pl. XXI. fig. 12. Shell slightly attenuated and gaping behind, lamellated concentrically; cartilage-process prominent; pallial sinus very wide. *Distr.* 10 sp. In sponges, sand, and the fissures of rocks, — 7 fathoms. W. Indies, India, Australia, W. America. *Fossil,* Miocene —. Wilmington, N. Carolina.

Syndosmya, Recluz. *Syn.* Abra, Leach MS. Erycina (part) Lam. 1805.† *Type,* S. alba, Pl. XXI. fig. 13. *Shell* small, oval, white and shining; posterior side shortest; umbones directed backwards; cartilage-process oblique; hinge-teeth minute or obsolete, laterals distinct; pallial sinus wide and shallow. *Animal* with the mantle open, fringed; siphons long, slender, diverging, anal shortest, orifices plain; foot large, tongue-shaped, pointed; palpi triangular, nearly as large as the gills; branchiæ unequal, triangular. *Distr.* Norway, Brit. Medit. Black Sea, India. The sp. are few, and mostly boreal, ranging from the laminarian zone to 180 fms. (*Forbes.*) They live buried in sand and mud, but when confined are able to creep up the sides of the vessel with their foot. (*Bouchard.*) *Fossil,* 6 sp. Eocene —. Brit. France.

Scrobicularia, Schumacher. *Syn.* Trigonella (part) Da Costa (not L.) Ligula (part)). Mont. "Le Lavignon" (Reaumur) Cuv. Listera, Turt. (not R. Brown.) Lutricola, Bl. Mactromya, D'Orb. (not Ag.) *Type,* S. piperata (Belon) Gmelin, Pl. XXI. fig. 14. (See p. 60.) *Shell* oval, compressed, thin; sub-equi-lateral; ligament external, slight; cartilage-pit shallow, triangular; hinge-teeth small, 1 or 2 in each valve, laterals obsolete; pallial sinus wide and deep.

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* The name *Amphi-desma,* as employed by Lamarck, included species of *Semele, Loripes, Syndosmya, Mesodesma, Thracia, Lyonsia,* and *Kellia;* in addition to which it has since been applied to some Oolitic *Myacites.*

† The name *Erycina* was originally appplied by Lamarck to a number of minute fossil shells, including sp. of *Syndosmya, Venus, Lucina, Tellina, Astarte,* and *Kellia.* In 1808 Fabricius employed it for a well-known group of insects.

Animal with the mantle open, margins denticulated; siphons very long, slender, separate, orifices plain; foot large, tongue-shaped, compressed; palpi very large, triangular, gills minutely striated, the outer pair directed dorsally. Lives buried, vertically, in the mud of tidal estuaries, 5 or 6 inches deep. (*Montagu.*) The siphons can be extended to 5 or 6 times the length of the shell. (*Deshayes*). The animal has a peppery taste, but is sometimes eaten on the coasts of the Mediterranean. *Distr.* Norway, Brit. Medit. Senegal. *Fossil,* Pliocene, Brit.

MESODESMA, Deshayes.

Etym. Meso- middle, *desma* ligament. *Syn.* Eryx, Sw. (not Daud.) Paphia (part) Lam. 1799 (see p. 299, note). Erycina (part) Lam. 1818 (not Lam. 1805, nor Fabr. 1808). "Donacille," Lam. 1812 (not characterized).

Examples, M. glabratum, Pl. XXI. fig. 15. M. donacium. fig. 16.

Shell trigonal, thick, compressed, closed; ligament internal, in a deep central pit; a minute anterior hinge-tooth, and 1 – 1 lateral teeth in each valve; muscular scars deep, pallial sinus small.

Animal with mantle-margins plain; siphons short, thick, and separate, orifices cirrated, branchial cirri dendritic; foot compressed, broadly lanceolate: gills large, unequal; palpi small.

Sub-genus. Anapa, Gray. A. Smithii, Pl. XXI. fig. 17. Umbones anterior, siphonal inflection obsolete.

Distr. 20 sp. W. Indies, Medit. Crimea, India, New Zealand, Chili; sands at low-water.

Fossil, 7 sp. Neocomian —. U. S. Europe (*Donacilla,* D'Orb.)

ERVILIA, Turton. Lentil-shell.

Etym. Ervilia, diminutive of *ervum,* the bitter-vetch.

Type, E. nitens, P. XXI. fig. 18.

Shell minute, oval, close; cartilage in a central pit; right valve with a single prominent tooth in front and an obscure tooth behind; left valve with 2 obscure teeth; no lateral teeth; pallial sinus deep.

Distr. W. Indies, Brit. Canaries, Medit. Red Sea. — 50 fms.

DONAX, L. Wedge-shell.

Ex. D. denticulatus, Pl. XXI. fig. 19. *Etym. Donax,* a sea-fish, Pliny.

Syn. Chione, Scop. Cuneus, Da Costa. Capisterium, Meusch.* Latona and Hecuba, Schum. Egeria, Lea (not Roissy).

Shell trigonal, wedge-like, closed; front produced, rounded; posterior side short, straight; margins usually crenulated; hinge-teeth 2.2; laterals

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* Meuschen was a Dutch auctioneer; the names occur in his "sale catalogues." *Idiotæ imposuere nomina absurda.* Linnæus.

1—1 in each valve; ligament external, prominent; pallial sinus deep, horizontal.

Animal with the mantle fringed; siphons short and thick, diverging, anal orifice denticulated, branchial with pinnate cirri; foot very large, pointed, sharp-edged, projected quite in front; gills ample, recumbent, outer shortest; palpi small, pointed.

Distr. 45 sp. Norway, Baltic, — Black Sea, all tropical seas. In sands near low-water mark (— 8 fms.) buried an inch or two beneath the surface.

Fossil, 30 sp. Eocene —. U. States, Europe.

Sub-genera. ? *Amphichæna,* Phil. A. Kindermanni, California. *Shell* oblong, nearly equilateral, gaping at each end; teeth $\frac{2}{3}$; ligament external, pallial line sinuated.

Iphigenia, Schum. (Capsa, Lam. 1818, not 1801. Donacina, Fér.) I. Brasiliensis, Pl. XXI. fig. 20. *Shell* nearly equilateral, smooth; hinge-teeth 2.2, one bifid, the other minute; laterals remote, obsolete in the left valve; margins smooth. *Distr.* 4 sp. W. Indies, Brazil, W. Africa, Pacific, Central America. Inhabits estuaries; *I. ventricosa,* Desh. is rayed like *Galatea,* and has its beaks eroded.

? *Isodonta* (Deshayesii) Buv. Bull. Soc. Geol. *Oxf.* France.

GALATEA, Bruguière.

Syn. Egeria, Roissy. Potamophila, Sby. Megadesma, Bowdich.

Type, G. reclusa, Pl. XXI. fig. 21.

Shell very thick, trigonal, wedge-shaped; epidermis smooth, olive; umbones eroded; hinge thick, teeth 1.2, laterals indistinct; ligament external, prominent; pallial sinus distinct.

Animal with the mantle open in front; siphons moderate, with 6—8 lines of cilia, orifices fringed; foot large, compressed; palpi long, triangular; gills unequal, united to the base of the siphons, the external pair divided into 2 nearly equal areas by a longitudinal furrow, indicating their line of attachment.

Distr. 2 or 7 sp.? Nile, and rivers of W. Africa.

FAMILY XVII. SOLENIDÆ.

Shell elongated, gaping at the ends; ligament external; hinge-teeth usually 2.3, compressed, the posterior bifid. External shell layer with definite cell-structure, consisting of long prisms, very oblique to the surface, and exhibiting nuclei; inner layer nearly homogeneous.

Animal with a very large and powerful foot, more or less cylindrical: siphons short and united (in the typical Solens, with long shells) or longer and partly separate (in the shorter and more compressed genera); gills narrow, prolonged into the branchial siphon.

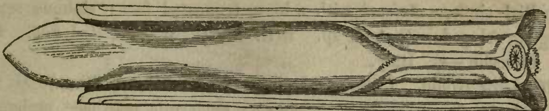

Fig. 219. Solen siliqua, L. $\frac{1}{3}$; the valves forcibly opened, and mantle divided as far as the ventral foramen, to show the foot.

Solen (Aristotle) L. Razor-fish.

Type, S. siliqua, Pl. XXII. fig. 4.

Syn. Hypogæa, Poli. Vagina, Megerle. Ensis, Schum. Ensatella, Sw.

Shell very long, sub-cylindrical, straight, or slightly recurved, margins parallel, ends gaping: beaks terminal, or sub-central; hinge-teeth $\frac{2}{2}$; ligament long, external; anterior muscular impression elongated; posterior oblong; pallial line extending beyond the adductors; sinus short and square.

Animal with the mantle closed except at the front end, and a minute ventral opening; siphons short, united, fringed; palpi broadly triangular; foot cylindrical, obtuse.

Distr. 25 sp. World-wide, except Arctic seas:—100 fms.

Fossil, 10 sp. Eocene —. U. States, Europe.

The Razor-fishes live buried vertically in the sand, at extreme low-water, their position being only indicated by an orifice like a key-hole; when the tide goes out they sink deeper, often penetrating to a depth of 1 or 2 feet. They never voluntarily leave their burrows, but if taken out soon bury themselves again. They may be caught with a bent wire, and are excellent articles of food, when cooked. (*Forbes.*)

Cultellus, Schumacher.

Type, C. lacteus, Pl. XXII. fig. 5. *Etym. Cultellus* a knife.

Shell elongated, compressed, rounded and gaping at the ends; hinge-teeth 2.3; beaks in front of the centre, supported internally by an oblique rib; pedal impression behind the umbonal rib; posterior adductor trigonal; pallial line not prolonged behind the posterior adductor; sinus short and square.

Animal (of C. Javanicus) with short, fringed siphons; gills narrow, half as long as the shell, transversely plaited; palpi large, angular, broadly attached; foot large, abruptly truncated.

Distr. 4 sp. Africa, India, Nicobar.

Sub-genera. Ceratisolen, Forbes. (Polia, D'Orb. Pharus, Leach, MS. Solecurtoides, Desm.) C. legumen, Pl. XXII. fig. 6. *Shell* narrow, sub-equilateral, anterior adductor impressions elongated, a second pedal scar near the pallial sinus. *Animal* with a long, truncated foot; siphons separate, diverging, fringed. *Distr.* 1 sp. Brit. Medit. Senegal, Red Sea. *Fossil,* 1 sp. Pliocene —. Italy.

Machæra, Gould. (Siliqua, Megerle. Leguminaria, Schum.) M. polita, Pl. XXII. fig. 7. *Shell* smooth, oblong; epidermis polished; umbonal rib extending across the interior of the valve; pallial sinus short. The animal, figured hy Middendorff, is similar to *Solecurtus. Distr.* India, China, Ochotsk, Oregon, Sitka, Behring's Sea, Newfoundland. *M. costata,* Say, is often obtained from the maw of the cod-fish. *Fossil,* 4 sp. U. Greensand —. Brit. France.

SOLECURTUS, Blainville.

Etym. Solen and *curtus,* short.

Syn. Psammosolen Risso. Macha, Oken. Siliquaria, Schum.

Ex. S. strigilatus, Pl. XXII. fig. 8. S. Caribæus, Pl. XXII. fig. 9.

Shell elongated, rather ventricose, with sub-central beaks; margins subparallel; ends truncated, gaping; ligament prominent; hinge-teeth $\frac{2}{2}$; pallial sinus very deep, rounded; posterior adductor rounded.

Animal very large and thick, not entirely retractile within the shell; mantle closed below; pedal orifice and foot large; palpi triangular, narrow, lamellated inside; gills long and narrow, outer much shortest; siphons separate at the ends, united and forming a thick mass at their bases; anal orifices plain, branchial fringed.

The *Solecurti* bury deeply in sand or mud, usually beyond low-water, and are difficult to obtain alive. *P. Caribæus* occurs in countless myriads in the bars of American rivers, and on the coast of New Jersey in sand exposed at low-water; by removing 3 or 4 inches of sand its burrows may be discovered; they are vertical cylindrical cavities, 1½ inches in diameter and 12 or more deep, the animal holds fast by the expanded end of its foot.

Distr. 25 sp. U. States, Brit. Medit. W. Africa, Madeira.

Fossil, 30 sp. Neocomian —. U. S. Europe.

Sub-genus, Novaculina, Benson. N. gangetica, Pl. XXII. fig. 10. *Shell,* oblong, plain; epidermis thick and dull; pallial sinus rather small; anterior pedal scar linear. *Distr.* India, China. In the mud of river-estuaries.

FAMILY XVIII. MYACIDÆ.

Shell thick, strong and opaque; gaping posteriorly; pallial line sinuated; epidermis wrinkled. Structure more or less distinctly cellular, with dark nuclei near outer surface; cartilage process composed of radiated cells.

Animal with the mantle almost entirely closed; pedal aperture and foot small; siphons united, partly or wholly retractile; branchiæ 2 on each side, elongated.

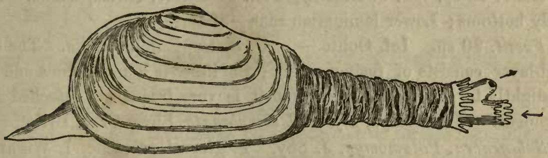

Fig. 220. *Mya truncata*, L. ½. Brit. (after Forbes.)

MYA, L. Gaper.

Etym. Myax (-acis) a mussel, Pliny. *Syn.* Platyodon, Conrad.

Types, M. truncata, Pl. XXIII. fig. 1. M. Arenaria, fig. 170, p. 244.

Shell oblong, inequivalve, gaping at the ends; left valve smallest, with a large flattened cartilage process; pallial sinus large.

Animal with a small straight linguiform foot; siphons combined, covered with epidermis, partially retractile; orifices fringed, the branchial opening with an inner series of large tentacular filaments; gills not prolonged into the siphon; palpi elongated, free.

M. anatina, Chemn. (Tugonia, Gray) W. coast of Africa; posterior side extremely truncated; similar cartilage-processes in each valve. *Fossil, Miocene*, Dax, and the Morea.

Distr. 10 sp. Northern Seas, W. Africa, Philippines, Australia, California. The Myas frequent soft bottoms, especially the sandy and gravelly mud of river-mouths; they range from low-water to 25 fathoms, rarely to 100 or 145 fms. *M. arenaria* burrows a foot deep; this species and *M. truncata* are found throughout the northern and Arctic seas, from Ochotsk and Sitka to the Russian Ice-meer, the Baltic, and British coast; in the Mediterranean they are only found fossil. They are eaten in Zetland and N. America, and are excellent articles of food. In Greenland they are sought after by the walrus, the Arctic fox, and birds. (*O. Fabricius.*)

Fossil, Miocene —. U. States, Brit. Sicily. Most of the fossil "Myas" have an external ligament, and are related either to *Panopæa* or *Pholadomya*.

CORBULA, Bruguière.

Etym. Corbula, a little basket. *Type*, C. sulcata, Pl. XXIII. fig. 2.

Syn. Erodona, Daud. (= Pacyodon, Beck.) Agina, Turt.

Shell thick, inequivalve, gibbose, closed, produced posteriorly; right valve with a prominent tooth in front of the cartilage pit; left valve smaller, with a projecting cartilage process; pallial sinus slight: pedal scars distinct from the adductor impressions.

Animal with very short, united siphons; orifices fringed; anal valve tubular; foot thick and pointed; palpi moderate; gills 2 on each side, obscurely striated.

Distr. 50 sp. U. S. Norway, Brit. Medit. W. Africa, China. Inhabits sandy bottoms; Lower laminarian zone—80 fms.

Fossil. 90 sp. Inf. Oolite —. U. States, Europe, India. The external shell-layer consists of fusiform cells; the inner is homogeneous and adheres so slightly to the outer layer, that it is very frequently detached in fossil specimens. Corbulomya, Nyst (*C. complanata*, Sby.) Crag. Brit.

Sub-genera. Potamomya, J. Sby. P. gregaria, Eocene, I. Wight. Cartilage process broad and spatulate, received between two obscure teeth in the right valve. The estuary *Corbulæ* differ very little from the marine species. *P. labiata* (Azara, D'Orb.) Pl. XXIII. fig. 3, lives buried in the mud of the R. Plata, but not above Buenos Ayres, and consequently in water which is little influenced by the superficial ebb of the river. The same species is found in banks widely dispersed over the Pampas near S. Pedro, and many places in the Argentine Republic, 5 yards above the R. Parana. (*Darwin.*)

Sphenia, Turt. S. Binghami, Pl. XXIII. fig. 4. *Shell* oblong; right valve with a curved, conic tooth in front of the oblique, sub-trigonal cartilage-pit. *Animal* with thick united siphons, fringed at the end, anal valve conspicuous; foot finger-like, with a byssal groove. *Distr.* Brit. France. Burrowing in oyster-shells and limestone, in 10—25 fms. *Fossil*, Miocene —. Brit.

NEÆRA, Gray.

Etym. Neæra, a Roman lady's name.

Type, N. cuspidata, Pl. XXIII. fig. 5. *Syn.* Cuspidaria, Nardo.

Shell globular, attenuated and gaping behind; right valve a little the smallest; umbones strengthened internally by a rib on the posterior side; cartilage process spatulate, in each valve, (furnished with a moveable ossicle, *Deshayes*) with an obsolete tooth in front, and a posterior lateral tooth; pallial sinus very shallow.

Animal with the mantle closed; foot lanceolate; siphons short, united, branchial largest, anal with a membranous valve, both with a few long, lateral cirri.

Distr. 20 sp. Norway, Brit. Medit, Canaries, Madeira, China, Moluccas, New Guinea, Chile. From 12—200 fms.

Fossil, 6 sp. Oolite —. Brit. Belgium, Italy.

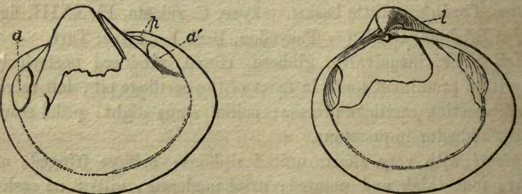

Fig. 221. *Thetis, minor*, Sby. *Neocomian*, I. Wight.

Thetis, Sowerby.

Etym. Thetis, in Greek myth. a sea-nymph.

Syn. Poromya (anatinoides) Forbes. Embla (Korenii) Lovén ?. Inoceramus (impressus) D'Orb. ? Corbula (gigantea) Sby.

Type, T. minor, fig. 221. T. hyalina, Pl. XXII. fig. 11.

Shell sub-orbicular, ventricose, thin, translucent, surface regularly granulated, interior slightly nacreous; ligament (*l*) external; hinge-teeth 1 or 2; umbones strengthened inside by a posterior lamina; adductor (*a, a'*) and pedal impressions (*p*) separate, slightly impressed, posterior adductor bordered by a ridge; pallial line nearly simple, sub-marginal.

Animal with short siphons, the branchial largest, surrounded at their base by 18—20 tentacles, generally reflected on the shell; mantle open in front; foot long, narrow and slender. (*M'Andrew.*)

Distr. 5 sp. Norway, Brit. Medit. Madeira, Borneo, China. 40—150 fms.

Fossil, 7 sp. Neocomian —. Brit. Belgium, France, S. India.

Sub-genus ? *Eucharis,* Recluz; Corbula quadrata, Hinds, Guadaloupe. *Shell* equivalve, obliquely keeled, gaping; beaks anterior; hinge-teeth 1—1; ligament external; pallial line simple; surface granulated.

Panopæa, Menard de la Groye.

Etym. Panopè, a Nereid. *Ex.* P. Americana, Pl. XXII. fig. 12.

Syn. ? Pachymya (gigas) Sby. U. Greensand. Brit. France.

Shell equivalve, thick, oblong, gaping at each end; ligament external, on prominent ridges; 1 prominent tooth in each valve; pallial sinus deep.

Animal with very long, united siphons, invested with thick, wrinkled epidermis; pedal orifice small, foot short, thick and grooved below; gills long and narrow, extending far into the branchial siphon, the outer pair much narrower, faintly pectinated; palpi long, pointed and striated.

In *P. Norvegica* the pallial line is broken up into a few scattered spots, as in *Saxicava*; the animal itself is like a gigantic Saxicava. (*Hancock.*) This species ranges from Ochotsk to the White Sea, Norway and N. Britain; it was formerly an inhabitant of the Medit. where it now occurs fossil. (= P. *Bivonæ,* Phil.) The British specimens have been caught, accidentally, by the deep-water fishing-hooks. *P. australis* is found at Port Natal, buried in the sand at low-water; the projecting siphons first attracted attention (doubtless by the strong jets of water they sent up when molested) but the shells were only obtained by digging to the depth of several feet. The Medit. sp. *P. glycimeris* attains a length of 6 or 8 inches.

Distr. 6 sp. Northern Seas, Medit. Cape, Australia, New Zealand, Patagonia. Low-water—90 fms.

Fossil, 140 sp. Inf. Oolite —. U. States, Europe, India.

SAXICAVA, Bellevue.

Etym. Saxum, stone, *cavo*, to excavate. S. rugosa, Pl. XXII. fig. 13.

Syn. Byssomya, Cuv. Rhomboides, Bl. Hiatella (minuta) Daud. Biapholius, Leach. Arcinella (carinata) Phil.

Shell when young symmetrical, with 2 minute teeth in each valve; adult rugose, toothless; oblong, equivalve, gaping, ligament external; pallial line sinuated, not continuous.

Animal with mantle-lobes united and thickened in front; siphons large, united nearly to their ends, orifices fringed; pedal opening small, foot finger-like, with a byssal groove; palpi small, free; gills narrow, unequal, united behind and prolonged into the branchial siphon.

Five genera and 15 species have been manufactured out of varieties and conditions of this Protean shell. It is found in crevices of rocks and corals, and amongst the roots of sea-weed, or burrowing in limestone and shells; at Harwich it bores in the cement stone (clay iron-stone), at Folkestone in the Kentish-rag, and the Portland stone employed in the Plymouth Breakwater has been much wasted by it. Its crypts are sometimes 6 inches deep (*Couch*); they are not quite symmetrical, and like those of the *Lithodomus* are inclined at various angles, so as to invade one another, the last comers cutting quite through their neighbours; they are usually fixed by the byssus to a small projection from the side of the cell. The Saxicava ranges from low-water to 140 fathoms; it is found in the Arctic Seas, where it attains its largest size; in the Medit, at the Canaries, and the Cape. It occurs fossil in the Miocene tertiary of Europe and in the U. States, and in all the Glacial deposits.

GLYCIMERIS, Lamarck.

Etym. Glukus, sweet, *meris*, bit.

Type, G. siliqua, Pl. XXII. fig. 14. *Syn.* Cyrtodaria, Daud.

Shell oblong, gaping at each end; posterior side shortest; ligament large and prominent; epidermis black, extending beyond the margins; anterior muscular scar long, pallial impression irregular, slightly sinuated.

Animal larger than its shell, sub-cylindrical; mantle closed, siphon united, protected by a thick envelope; orifices small; pedal opening small anterior; foot conical; palpi large, striated inside, the posterior border plain; gills large, extending into branchial siphon.

Distr. Arctic Seas, Cape Parry, N. W. America, Newfoundland.

Fossil, Miocene —. Brit. Belgium.

FAMILY XIX. ANATINIDÆ.

Shell often inequivalve, thin; interior nacreous; surface granular; ligament external, thin; cartilage internal, placed in corresponding pits and furnished with a free ossicle; muscular impressions faint, the anterior elongated; pallial line usually sinuated.

Animal with mantle margins united; siphons long, more or less united, fringed; gills single on each side, the outer lamina prolonged dorsally beyond the line of attachment.

Pholadomya and its fossil allies have an external ligament only; *Cochlodesma* and *Pandora* have no ossicle. The external surface of these shells is often rough with large calcarious cells, sometimes ranged in lines, and covered by the epidermis; the outer layer consists of polygonal cells, more or less sharply defined; the inner layer is nacreous.

ANATINA, Lamarck. Lantern-shell.

Type, A. rostrata, Pl. XXIII. fig. 7. (*Anatinus*, pertaining to a duck.)

Syn. Laternula, Bolten M. S. Auriscalpium, Muhlf. Osteodesma, Bl. Cyathodonta (undulata) Conrad ? W. America.

Shell oblong, ventricose, sub-equivalve, thin and translucent, posterior side attenuated and gaping; umbones fissured, directed backwards, supported internally by an oblique plate; hinge with a spoon-shaped cartilage-process in each valve, furnished in front with a transverse ossicle; pallial sinus wide and shallow.

Animal with a closed mantle and long united siphons, clothed with wrinkled epidermis; gills one on each side, thick, deeply plaited; palpi very long and narrow; pedal opening minute, foot very small, compressed.

Distr. 20 sp. India, Philippines, New Zealand, W. America.

Fossil, 50 sp. Devonian ? — Oolite —. U. States, Europe.

Sub-genera. Periploma (inequivalvis) Schum. "Spoon-hinge" of Petiver; oval, inequivalve, left valve deepest; posterior side very short and contracted. *Distr.* W. Indies, S. America.

Cochlodesma, Couthouy, C. prætenue, Pl. XXIII. fig. 8. (Bontia, Leach MS. Ligula, Mont. part.) Oblong, compressed, thin, slightly inequivalve; umbones fissured; cartilage processes prominent, without an ossicle; pallial sinus deep. *Animal* with a broad, compressed foot; siphons long, slender, divided throughout; gills one on each side, deeply plaited, divided by an oblique furrow into two parts, the dorsal portion being narrower, composed of a single lamina only, and attached by its whole inner surface. (*Hancock.*) *Distr.* 2 sp. U. States, Brit. Medit. *Fossil*, Pliocene, Sicily.

Cercomya, Agassiz. C. undulata, Sby. (= Rhynchomya, Ag.) *Shell* very thin, elongated, compressed, attenuated posteriorly; sides concentrically furrowed, umbones fissured, posterior (cardinal) area more or less defined. *Fossil*, 12 sp. Oolite — Neocomian; Europe.

THRACIA (Leach) Bl.

Syn. Odoncinetus, Costa. Corimya, Ag. Rupicola (concentrica) Bellevue.

Type, T. pubescens, Pl. XXIII. fig. 9.

Shell oblong, nearly equivalve, slightly compressed, attenuated and gaping posteriorly, smooth or minutely scabrous; cartilage processes thick, not prominent, with a crescentic ossicle; pallial sinus shallow. Quter shell layer composed of distinct, nucleated cells.

Animal with the mantle closed; foot linguiform; siphons rather long, separate, with fringed orifices; gills single, thick, plaited; palpi narrow, pointed.

T. concentrica and *T. distorta*, Mont. are found in the crevices of rocks, and burrows of *Saxicava;* they have been mistaken for boring-shells.

Distr. 10 sp. Greenland, U. States, Norway, Brit. Medit. Canaries, China, Sooloo: 4—110 fms.

Fossil, 30 sp. (Trias ?) L. Oolite —. U. States, Europe.

PHOLADOMYA, G. Sowerby.

Recent Type, P. candida. Pl. XXII. fig. 15. I. Tortola.

Shell oblong, equivalve, ventricose, gaping behind; thin and translucent, ornamented with radiating ribs on the sides; ligament external; hinge with one obscure tooth in each valve; pallial sinus large.

Animal with a single gill on each side, thick, finely plaited, grooved along its free border, the outer lamina prolonged dorsally; mantle with a fourth (ventral) orifice. (*Owen.*)

Fossil, 150 sp. Lias —. U. S. Europe, Algeria, Thibet.

Homomya (hortulana) Ag. *Shell* thick, concentrically furrowed, without radiating ribs; 6 sp. Oolites, Europe.

MYACITES (Schlotheim) Bronn.

Syn. Myopsis (Jurassi) Ag. Pleuromya, Ag. Arcomya (Helvetica) Ag. Mactromya (mactroides) Ag. Anoplomya (lutraria) Krauss.

Ex. M. sulcatus, Flem. (Allorisma, King, Pal. Tr. 1850, Pl. XX. fig. 5.)

Shell oblong, ventricose, gaping, thin, often concentrically furrowed; umbones anterior; surface granulated; ligament external; hinge with an obscure tooth or edentulous; muscular impressions faint; pallial line deeply sinuated.

Fossil, 50 sp. L. Silurian — L. Chalk. U. S. Europe, S. Africa.

Sub-genera ? *Goniomya*, Ag. Mya literata, Pl. XXII. fig. 16. (Lysianassa, Münster, not M. Edw.) *Shell* equivalve, thin, granulated; ligament external, short, prominent. *Fossil*, 30 sp. U. Lias — Chalk. Europe.

Tellinomya (nasuta) Hall; *Silurian*, U. S. Europe. Not characterised.

? *Grammysia*, Verneuil. Nucula cingulata, His. *U. Silurian*, Europe. Valves with a strong transverse fold extending from the umbones to the middle of the ventral margin.

? *Sedgwickia* (corrugata) M'Coy. = ? Leptodomus (senilis) M'Coy.

Shell thin, ventricose, concentrically furrowed in front; escutcheon long and flat. Silurian — Carb. Europe.

CEROMYA, Agassiz.

Etym. Keraos horned, *mya*, mussel.

Type, C. concentrica (Isocardia) Sowerby, Min. Con. 491, fig. 1.

Shell Isocardia-shaped, slightly inequivalve ? very thin, granulated, often eccentrically furrowed; ligament external; hinge edentulous; right valve with an internal lamina behind the umbo; pallial line scarcely sinuated?

Fossil, 14 sp. Inf. Oolite —. Green-sand ? Europe.

Sub-genus ? *Gresslya* (sulcosa) Ag. (Amphidesma and Unio. sp. Phil.) *Shell* oval, rather compressed; umbones anterior, incurved, not prominent; valves thin, close, smooth or concentrically furrowed; pallial sinus deep. *Fossil*, 17 sp. Lias — Portlandian. Europe. The lamina within the posterior hinge-margin of the right valve produces a furrow in the casts, which are more common than specimens retaining the shell.

? CARDIOMORPHA, Koninck.

Type, C. oblonga (Isocardia) Sby. (not Kon.) Carb. lime.

Shell Isocardia-shaped, smooth or concentrically furrowed, umbones prominent, hinge edentulous; hinge-margin with a narrow ligamental furrow, and an obscure internal cartilage-groove.

Fossil, 38 sp. L. Silurian — Carb. N. America, Europe.

EDMONDIA, Koninck.

Ex. E. sulcata, Ph. (T. Pal. Soc. 1850, Pl. XX. fig. 5.) Carb. Brit.

Syn. Allorisma, King (part). Sanguinolites, M'Coy (part).

Shell oblong, equivalve, thin, concentrically striated, close; umbones anterior; ligamental grooves narrow, external; hinge-line thin, edentulous, furnished with large oblique cartilage-plates, placed beneath the umbones, and leaving space for an ossicle ? pallial line simple ?

Fossil, 4 sp. Carb. — Permian. Europe.

LYONSIA, Turton, 1822 (not R. Brown).

Syn. Magdala, Leach, 1827. Myatella, Brown. Pandorina, Scacchi.

Type, L. Norvegica, Pl. XXIII. fig. 10.

Shell nearly equivalve, left valve largest, thin, sub-nacreous, close, truncated posteriorly; cartilage plates oblique, covered by an oblong ossicle; pallial sinus obscure, angular. Structure intermediate between *Pandora* and *Anatina;* outer layer composed of definite polygonal cells.

Animal with the mantle closed; foot tongue-shaped, grooved, byssiferous; siphons very short, united nearly throughout, fringed; lips large, palpi narrow, triangular.

Distr. 9 sp. Greenland, N. Sea, Norway, W. Indies, Madeira, India, Borneo, Philippines, Peru.

L. Norvegica ranges from Norway to the sea of Ochotsk; in 15—80 fms.

Fossil ? Miocene —. Europe. (100 sp. L. Sil. —. D'Orb.)

? *Entodesma* (Chilensis) Phil. *Shell* thin, saxicava-shaped, slightly inequivalve and gaping, covered with thick epidermis; hinge edentulous; each valve with a semi-circular process containing the cartilage.

PANDORA (Solander) Brug.

Type, P. rostrata, Pl. XXIII. fig. 11. (*Pandora*, the Grecian Eve.)

Shell inequivalve, thin, pearly inside; valves close, attenuated behind; right valve flat, with a diverging ridge and cartilage furrows; left valve convex, with two diverging grooves at the hinge; pallial line slightly sinuated. Outer layer of regular, vertical, prismatic cells, 250 times smaller than those of *Pinna* (fig. 260). (*Carpenter.*)

Animal with mantle closed, except a small opening for the narrow, tongue-shaped foot; siphons very short, united nearly throughout, ends diverging, fringed; palpi triangular, narrow; gills plaited, one on each side, with a narrow dorsal border.

Distr. 13 sp. U. States, Spitzbergen, Jersey, Canaries, India, N. Zealand, Panama: 4—110 fms. burrowing in sand and mud.

Fossil, 4 sp. Eocene —. U. States, Brit.

MYADORA, Gray.

Type, M. brevis, Pl. XXIII, fig. 12.

Shell trigonal, rounded in front, attenuated and truncated behind; right valve convex, left flat; interior pearly; cartilage narrow, triangular, between 2 tooth-like ridges in the left valve, with a free sickle-shaped ossicle; pallial line sinuated: structure like *Anatina*; outer cells large, rather prismatic.

Distr. 10 sp. N. Zealand, N. S. Wales, Philippines.

MYOCHAMA, Stutchbury.

Type, M. anomioides, Pl. XXIII. fig. 13.

Shell inequivalve, attached by the dextral valve and modified by form of surface of attachment; posterior side attenuated; left valve gibbose; cartilage internal, between 2 tooth-like projections in each valve, and furnished with a moveable ossicle; anterior muscular impression curved, posterior rounded, pallial sinus small.

Animal with mantle-lobes united; pedal opening and siphons surrounded by separate areas; siphons distinct, unequal, small, slightly fringed; a minute fourth orifice close to the base of the branchial siphon; visceral mass large, foot small and conical; mouth rather large, upper lip hood-like; palpi tapering, few-plaited; gills one on each side, triangular, plaited, divided by an oblique line into two portions; excurrent channels 4, 2 at the base of the gills and two below the dorsal laminæ. (Hancock, An. Nat. Hist. 1853.)

Distr. 3 sp. New South Wales; attached to Crassatella and Trigonia, in 8 fm. water; the fry (as indicated by the umbones) is free, regular, and Myadora-shaped.

CHAMOSTREA, Roissy.

Type, C. albida, Pl. XXIII. fig. 14. *Syn.* Cleidothærus, Stutch.

Shell inequivalve, chama-shaped, solid, attached by the anterior side of the deep and strongly-keeled dextral valve; umbones anterior, sub-spiral; left valve flat, with a conical tooth in front of the cartilage; cartilage internal, with an oblong, curved ossicle; muscular impressions large and rugose, the anterior very long and narrow; pallial line simple.

Animal with mantle-lobes united by their extreme edge between the pedal orifice and siphons; pedal opening small, with a minute ventral orifice behind it; siphons a little apart, very short, denticulated; body oval, terminating in a small, compressed foot; lips bilobed, palpi disunited, rather long and obtusely pointed; gills one on each side, large, oval, deeply plaited, prolonged in front between the palpi, united posteriorly; each gill traversed by an oblique furrow, the dorsal portion consisting of a single lamina with a free margin. (Hancock, An. Nat. Hist. Feb. 1853.)

Distr. 1 sp. New South Wales.

FAMILY XX. GASTROCHÆNIDÆ.

Shell equivalve, gaping; valves thin, edentulous, united by a ligament, sometimes cemented to a shelly tube when adult; adductor impressions 2, pallial line sinuated.

Animal elongated, truncated in front, produced behind into two very long, united, contractile siphons, with cirrated orifices; mantle-margins very thick in front, united, leaving a small opening for the finger-like foot; gills narrow, prolonged into the branchial siphon.

The shell-fish of this family, the *tubicolidæ* of Lamarck, are burrowers in mud or stone. They are often gregarious, living in myriads near low-water line, but are extracted from their abodes with difficulty.

GASTROCHÆNA, Spengler, 1783.

Type, G. modiolina, Pl. XXIII. fig. 15. (*Gaster,* ventral, *chæna,* gape.)

Shell regular, wedge-shaped, umbones anterior; gaping widely in front, close behind; ligament narrow, external; pallial sinus deep.

Animal with mantle closed, and thickened in front; foot finger-like, grooved, sometimes byssiferous, siphons long, separate only at their extremities; lips simple, palpi sickle-shaped, gills unequal, prolonged freely into the branchial siphon.

G. modiolina perforates shells and limestone; its holes are regular, about

2 inches deep and ½ inch diameter; the external orifice is hour-glass shaped, and lined with a shelly layer which projects slightly. When burrowing in oyster-shells it often passes quite through into the ground below, and then completes its abode by cementing such loose material as it finds into a flask-shaped case, having its neck fixed in the oyster-shell; in some fossil species the siphons were more separated, and the flasks have two diverging necks. The siphonal orifices are rarely 4-lobed; Pl. XXIII. fig. 15 a.

Distr. 10 sp. W. Indies, Brit. Canaries, Medit. Red Sea, India, Mauritius, Pacific Ids. Gallapagos, Panama:—30 fms.

Fossil, 20 sp. Inf. Oolite —. U. States, Europe.

Sub-genus. Chæna, Retz. 1788. C. mumia. Pl. XXIII. fig. 16. (= Fistulana clava, Lam.) *Shell* elongated, contained within a shelly tube; posterior adductor nearly central, with a pedal scar in front; siphonal inflection angular, with its apex joining the pallial line. Tube round, straight, tapering upwards, transversely striated, closed at the lower end when complete, and furnished with a perforated diaphragm behind the valves. *Distr.* Madagascar, India, Philippines, Australia; burrowing in sand or mud.

Fossil, Inf. Oolite —. U. S. Europe, S. India.

CLAVAGELLA, Lamarck.

Ex. C. bacillaris, Pl. XXIII. fig. 17.

Shell oblong, valves flat, often irregular or rudimentary, the left cemented to the side of the burrow, when adult, the right always free; anterior muscular impression small, posterior large, pallial line deeply sinuated. Tube cylindrical, more or less elongated, sometimes divided by a longitudinal partition; often furnished with a succession of siphonal fringes above, and terminating below in a disk, with a minute central fissure, and bordered with branching tubuli.

Animal with the mantle closed in front, except a minute slit for the foot, and furnished with tentacular processes; palpi long and slender; gills 2 on each side, elongated, narrow (floating freely in the branchial siphon ?)

Some specimens of the recent *C. aperta* have 3 frills to their tubes, and *C. bacillaris* has twice that number occasionally. They are formed by the siphonal orifices when the animal continues elongating, after having fixed its valve and ceased to burrow; or perhaps, in some instances, when it is compelled to lengthen its tubes upwards by the accumulation of sediment. Brocchi mentions that on breaking the tube of the fossil *C. echinata,* he sometimes found the shell of a *Saxicava* or *Petricola* beside the loose valve of the *Clavagella,* into whose tube they must have entered after its death. *C. elongata* is found in coral; *C. australis* lives at low tide, and spirts out water when alarmed. *Distr.* 6 sp. Medit. Australia, Pacific:—11 fms.

Fossil, 13 sp. U. Green-sand —. Brit. Sicily, S. India.

ASPERGILLUM, Lam. Watering-pot shell.

Type, A. vaginiferum, Pl. XXIII. fig. 18. *Syn*. Clepsydra, Schum.

Shell small, equilateral, cemented to the lower end of a shelly tube, the umbones alone visible externally; tube elongated, closed below by a perforated disk with a minute central fissure; siphonal end plain or ornamented with (1—8) ruffles.

Animal elongated; mantle closed, thickened and fringed with filaments in front; foot conical, anterior, opposed to a minute slit in the mantle; palpi lanceolate; gills long, narrow, united posteriorly, continued into and attached to the branchial siphon.

Distr. 4 sp. Red Sea, Java, Australia, N. Zealand; in sand.

Fossil, 1 sp. (A ? Leognanum, Hœning. *Miocene*, Bordeaux.)

FAMILY XXI. PHOLADIDÆ.

Shell gaping at both ends; thin, white, brittle and exceedingly hard; armed in front with rasp-like imbrications; without hinge or ligament, but often strengthened externally by accessory valves; hinge-plate reflected over the umbones, and a long curved muscular process beneath each; anterior muscular impression on the hinge-plate; pallial sinus very deep.

Animal club-shaped, or worm-like; foot short and truncated; mantle closed in front, except the pedal orifice; siphons large, elongated, united nearly to their ends; orifices fringed; gills narrow, prolonged into the exhalent siphon, attached throughout, closing the branchial chamber; palpi long; anterior shell-muscle acting as substitute for a ligament.

The *Pholadidæ* perforate all substances that are softer than their own valves (p. 242);* the burrows of Pholas are vertical, quite symmetrical, and seldom in contact. The ship-worms (*Teredines*) also make symmetrical perforations, and however tortuous and crowded never invade each other, guided either by the sense of hearing or by the yielding of the wood. The burrow has frequently a calcarious lining, within which the shell remains free; *Teredina* cements its valves to this tube when full-grown. The opening of the burrow, at first very minute, may become enlarged progressively by the friction of the siphons, which are furnished with a rough epithelium; but it usually widens with much more rapidity by the *wasting of the surface.* As the timber decomposes the shelly tubes of the *Teredo* project, and as the beach wears away the *pholas* burrows deeper.

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* M. Cailliaud has proved that these valves are quite equal to the work of boring in limestone, by imitating the natural conditions as nearly as possible, and *making such a hole with them*. Mr. Robertson also, has kept the living Pholades in blocks of chalk, by the sea-side at Brighton, and has watched the progress of the work. They turn from side to side never going more than half-round in their burrow, and cease to work as soon as the hole is deep enough to shelter them; the chalk powder is ejected at intervals by spasmodic contractions from the *branchial* siphon, the space between the shell and burrow being filled with this mud. (Journ. Conch. 1853, p. 311.) It is to be remarked that the condition of the Pholades is always related to the nature of the material in which they are found burrowing; in soft sea beds they attain the largest size and greatest perfection, whilst in hard, and especially gritty rock, they are dwarfed in size and all prominent points and ridges appear worn by friction. No notice has been taken of the hypothesis which ascribes the perforation of rocks, &c., to *ciliary action*, because, in fact, there is no current between the shell or siphons and the wall of the tube.

PHOLAS, L. Piddock.

Etym. Pholas, a burrowing shell-fish, from *pholeo,* to bore.

Type, P. dactylus, fig. 222. *Ex.* P. Bakeri, Pl. XXIII. fig. 19.

Shell elongated, cylindrical; dorsal margin protected by accessory valves; pallial sinus reaching the centre of the shell.

Animal with a large truncated foot, filling the pedal opening; body with a fin-like termination; combined siphons large, cylindrical, with fringed orifices.

The common piddock is used for bait on the Devon coast; its foot is white and translucent when fresh, like a piece of ice; the *hyaline stylet* (p. 29) lodged in it, is large and curious. *P. costata* is sold in the market of Havannah, where it is an article of food.

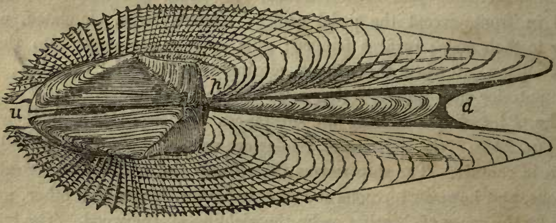

Fig . 22. *Pholas dactylus.* Chalk, Sussex Coast.

u, umbonal valves; *p,* post-umbonal valve; *d,* dorsal valve.

P. dactylus has two accessory valves to protect the umbonal muscle, with a small transverse plate behind; a long unsymmetrical plate fills up the space between the valves in the dorsal region. *P. candida* and *parva* have a single umbonal shield, and no dorsal plate; these differences are only of *specific* value. In *P. crispata,* L. (*Zirfæa,* Leach) the umbonal shield is not distinctly calcified, but there is a small posterior plate; the surface of the valves is divided into two areas by a transverse furrow.

Distr. 25 sp. U. S. Norway, Brit. W. Africa, Medit. Crimea, India, Australia, N. Zealand, W. America:—25 fms.

Fossil, 25 sp. (U. Lias —) Eocene —. U. States, Europe. The secondary species belong to the next group.

PHOLADIDEA, Turton, 1819.

Type, P. papyracea, Pl. XXIII. fig. 20.

Shell globose-oblong, with a transverse furrow; anterior gape large, closed in the adult by a callous plate; 2 minute accessory valves in front of the beaks.

Animal with a fringed disk at the end of the combined siphons, and a horny cup at their base.

Distr. 6 sp. Brit. N. Zealand, Ecuador. Low-tides—10 fms.

Sub-genera. Martesia (Leach) Bl. 1825. M. striata, Pl. XXIII. fig. 21 Valves lengthened behind, when full grown, by a plain border; umbonal valves 1 or 2; dorsal and ventral margins often with narrow accessory valves. 10 sp. W. Indies, Africa, India. *M. striata* burrows in hard timber. *M.terediniformis* was found in cakes of floating wax on the coast of Cuba. (G. B. Sby.) *M. australis* in (fossil ?) resin, on the coast of Australia. *M. rivicola* in timber 12 miles from the sea, in Borneo. *M. scutata*, Eocene, Paris, lines its burrow with shell.

Jouannetia (semicaudata) Desm. (Pholadopsis, Conrad; Triomphalia, Sby.) *Shell* very short, sub-globose; right valve longest behind: anterior opening closed by a callous plate developed from the left valve overlapping the margin of the right valve, and fixed to the single unsymmetrical umbonal plate. *Distr.* 3 sp. Philippines, W. America. *Fossil*, Miocene —. France.

Parapholas, Conrad, P. bisulcata, Pl. XXIII. fig. 22. Valves with 2 radiating furrows. *Distr.* 4 sp. California, Panama, Torres Strts.

XYLOPHAGA, Turton.

Etym. Xulon, wood, *phago*, to eat.

Types, X. dorsalis, Pl. XXIII. fig. 23; X. globosa, Sby. Valparaiso.

Shell globular, with a transverse furrow; gaping in front. closed behind; pedal processes short and curved; anterior margins reflected, covered by 2 small accessory valves; burrow oval, lined with shell.

Animal included within the valves, except the slender contractile siphons, which are furnished with pectinated ridges, and divided at the end; foot thick, very extensile.

Distr. 2 sp. Norway, Brit. S. America. Bores an inch deep, and across the grain, in floating wood, and timbers which are always covered by the sea.

TEREDO (Pliny) Adanson.

Type, T. Norvegica, Pl. XXIII. figs. 26, 27. *Syn.* Septaria, Lam.

Shell globular, open in front and behind, lodged at the inner extremity of a burrow partly or entirely lined with shell; valves 3 lobed, concentrically striated, and with one transverse furrow; hinge-margins reflected in front marked by the anterior muscular impressions; umbonal cavity with a long curved muscular process.

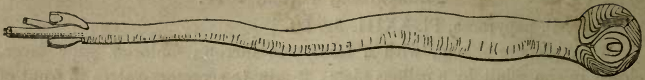

Fig. 223. Ship-worm, *Teredo Norvegica*, removed from its burrow.

Animal worm-like; mantle-lobes united, thickened in front, with a minute pedal opening; foot sucker-like, with a foliaceous border; viscera included in the valves, heart not pierced by the intestine; mouth with palpi; gills long, cord-like, extending into the siphonal tube; siphons very long, united nearly to the end, attached at the bifurcation and furnished with 2 shelly pallets or styles; orifices fringed.

T. navalis is ordinarily a foot long, sometimes 2½ feet; it destroys soft wood rapidly, and teak and oak do not escape; it always bores in the direction of the grain unless it meets the tube of another *Teredo*, or a knot in the timber.* In 1731-2 it did great damage to the piles in Holland, and caused still more alarm; metal sheathing, and broad-headed iron nails have been found most effectual in protecting piers and ship-timbers. The *Teredo* was first recognised as a bivalve mollusc by Sellius, who wrote an elaborate treatise on the subject, in 1733. (*Forbes.*)

T. corniformis, Lam. is found burrowing in the husks of cocoa-nuts and other woody fruits floating in the tropical seas; its tubes are extremely crooked and contorted, for want of space. The fossil wood and palm-fruits (*Nipadites*) of Sheppy and Brabant are mined in the same way. The tube of the giant Teredo (*T. arenaria*, Rumph. Furcella, Lam.) is often a yard long and 2 inches in its greatest diameter; when broken across it presents a radiating prismatic structure. The siphonal end is divided lengthwise, and sometimes prolonged into two diverging tubes. *T. Norvegica* and *T. denticulata* are divided longitudinally and also concamerated by numerous, incomplete transverse partitions, at the posterior extremity.

T. bipalmulata (Xylotrya, Leach) has the siphonal pallets elongated and penniform (Pl. XXIII. fig. 28); a species with similar styles occurs in the fossil wood of the Green-sand of Blackdown.

Distr. 14 sp. Norway, Brit. Black Sea; Tropics:—119 fms.

Fossil, 24 sp. Lias —. U. States, Europe.

Sub-genus, Teredina, Lam. T. personata, Pl. XXIII. figs. 24, 25. *Eocene*, Brit. France. *Valves* with an accessory plate in front of the umbones; free when young, united by their margins to the shelly tube when adult. The tube is sometimes concamerated; its siphonal end is often truncated; and the opening contracted by a lining which makes it hour-glass shaped, or six-lobed (fig. 25a.).

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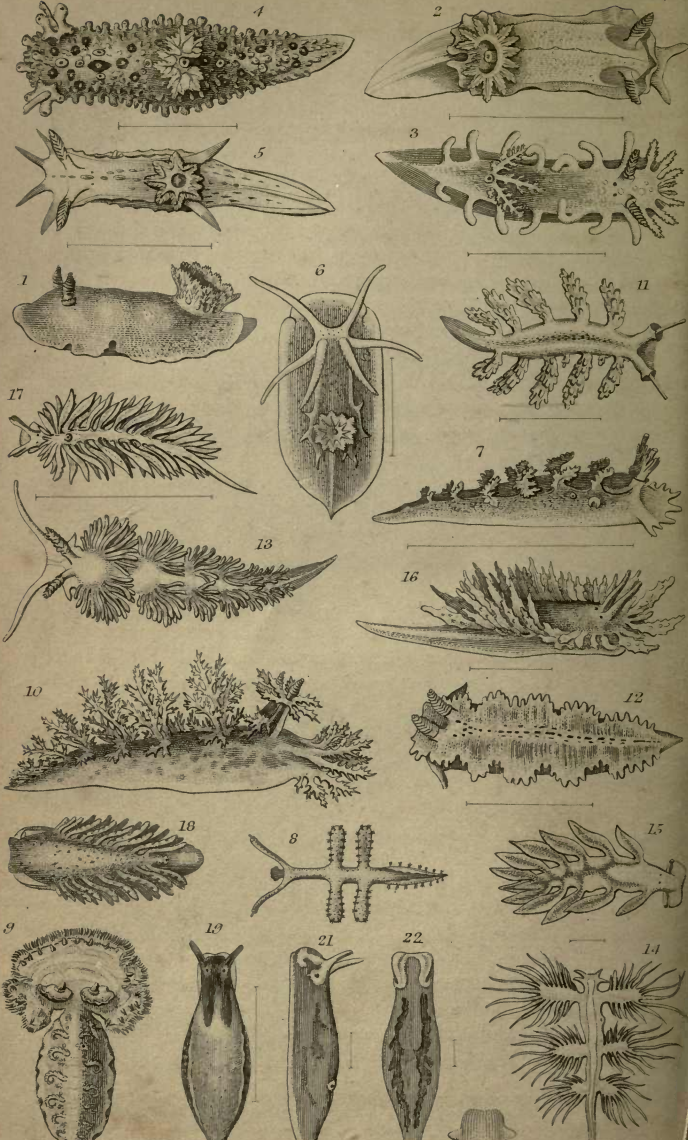
* The operations of the *Teredo* suggested to Mr. Brunel his method of tunnelling the Thames.

Pl. 13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S. P. Woodward

London, John Weale, 1854.

J. W. Lowry

PLATE XIII.

The real size of each species is indicated by the accompanying line.

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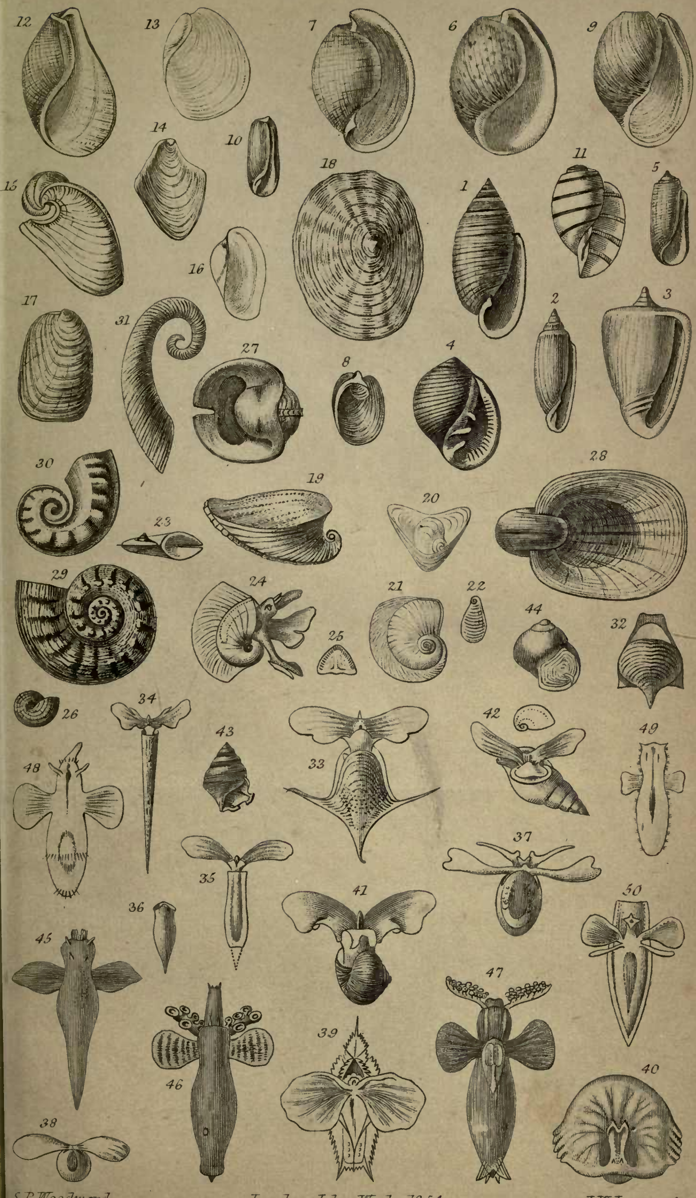
Pl. 14.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S.P. Woodward.

London, John Weale 1854.

J.W. Lowry fc.

Pl. 15

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18 – 22	Rhynconellida
23 – 26	Orthidæ
27 – 29	Productidæ
30	Craniadæ
31	Discinida
32	Lingulidæ

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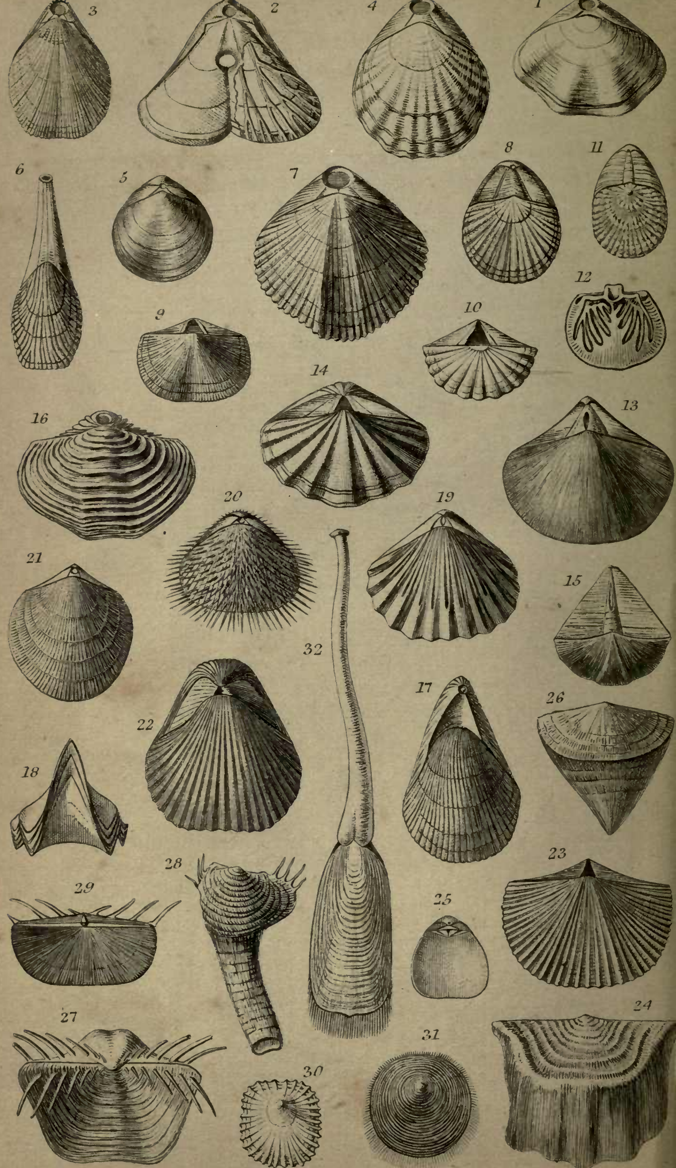
Pl.15.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S.P. Woodward London, John Weale, 1854. J.W. Lowry

PLATE XV.

All, except those marked *, are *dorsal* views.

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13. Stringocephalus Burtini, Defr. var. $\frac{1}{3}$. Devonian, Europe......... 222

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14. Spirifera Walcotti, Sby. $\frac{1}{2}$. Lias, Bath 223
15. Cyrtia exporrecta, Wahl. U. Silurian, Europe..... 223
16. Athyris lamellosa, Lév. $\frac{1}{2}$. Carb. limestone, N. Amer. — Europe 224
17. Uncites gryphus, Schl. $\frac{1}{2}$. Devonian, Belgium 225

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18.*Rhynchonella acuta, Sby. $\frac{2}{3}$. Lias, Europe 226
19. ———— furcillata, Buch. Lias, Europe 226
20. ———— spinosa, Schl. $\frac{2}{3}$. Inf. Oolite, Europe 226
21. Atrypa reticularis, L. sp. $\frac{1}{2}$. Sil.-Devon. N. Amer. — Europe ... 227
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23. Orthis rustica, J. Sby. $\frac{2}{3}$. U. Silurian, Europe 229
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25. Leptæna liassina, Bouch. $\frac{2}{1}$. Lias, Europe.............................. 231
26. Calceola sandalina, Lam. $\frac{1}{2}$. Devonian, Europe...................... 232

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27. Producta horrida, J. Sby. $\frac{1}{2}$. Magn. limestone, Europe............ 233
28.*———— proboscidea, Vern. $\frac{1}{2}$. Carb. limestone, Belgium......... 233
29. Chonetes striatella, Dalm. U. Silurian, Europe 235

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30. Crania Ignabergensis, Retz. Chalk, Sweden 236

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31. Discina lamellosa, Brod. $\frac{1}{2}$. Peru 237

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32. Lingula anatina, Lam. $\frac{1}{2}$. Philippines 239

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10.	—— (*Hinnites*) pusio, Pen. $\frac{2}{3}$. Brit.	258
11.	Lima squamosa, Lam. $\frac{1}{2}$. China	258
12.	—— (*Plagiostoma*) cardiiformis, Sby. Bath Oolite, Brit.	258
13.	—— (*Limatula*) sub-auriculata, Mont. Brit.	258
14.	—— (*Limæa*) strigilata, Brocchi sp. Pliocene, Italy	258
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21.	——— (*Vulsella*) lingulata, Lam. $\frac{1}{3}$. Red Sea	261
22.	Posidonomya Becheri, Bronn. Carb. Hesse, Brit.	262
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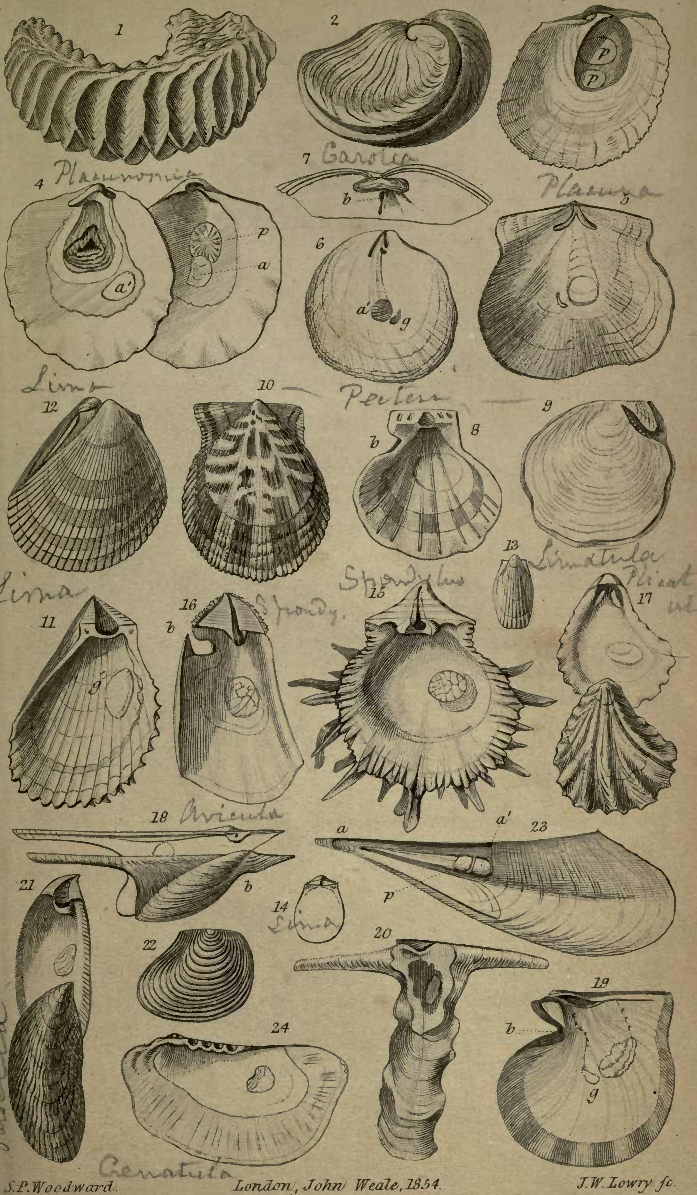
a,a' adductor impressions.
p, pedal muscles.
g, suspensors of the gills.
b, byssal foramen or notch.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p
p
4 Placunomia
a'
p
a
7 Carolia
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6
a'
g
Placuna
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Lima
12
10
Pecten
8
b
9
13 Limatula
Plicat
ula
Lima
Spondylus
11
g
16
b
Spondy.
15
17
18 Avicula
a
a'
23
b
p
21
14
Lima
22
20
24
19
b
g
Mytilus
Crenatula

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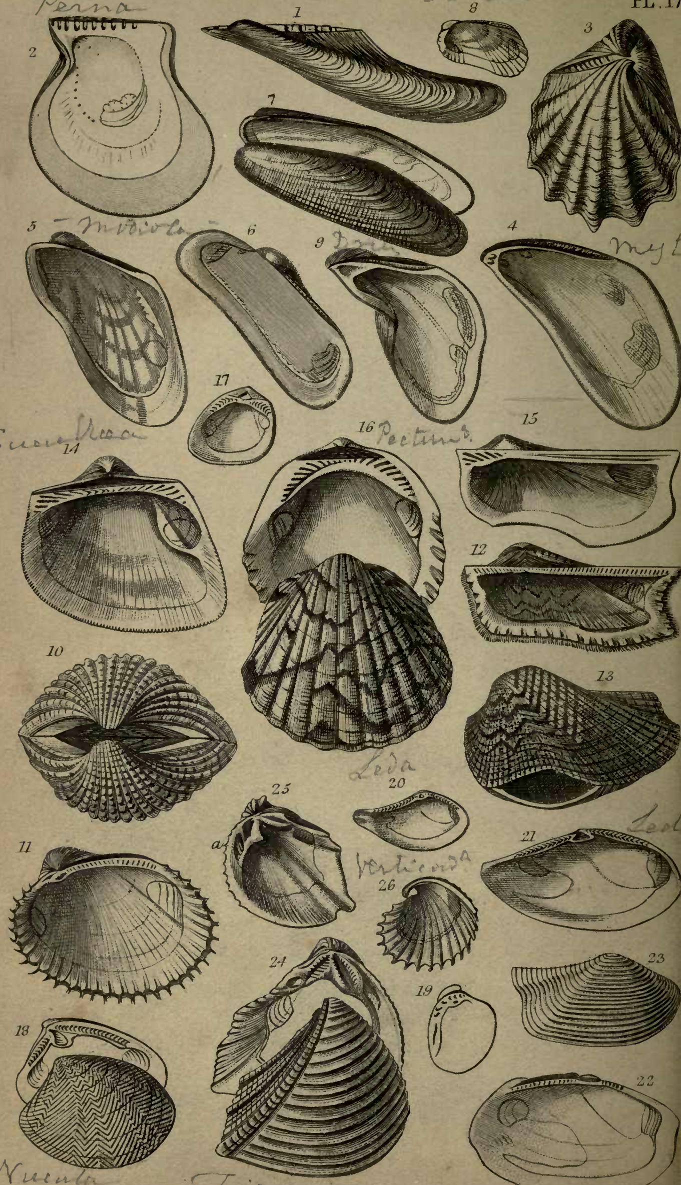
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Perna
Crenella
Modiola
Dreiss
Myt
Cucullaea
Pectunc.
Leda
Leol
Verticorda
Nucula
Trigonia
Solenella

S.P. Woodward.

London, John Weale, 1854.

PLATE XVII.

* The figures marked are left valves; (interiors).

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PLATE XVIII.

* The figures marked are *left* valves.

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19. *Megalodon cucullatus, J. Sby. ½. Devonian, Eifel 301

† The animal of *Hyria* has two siphonal orifices.

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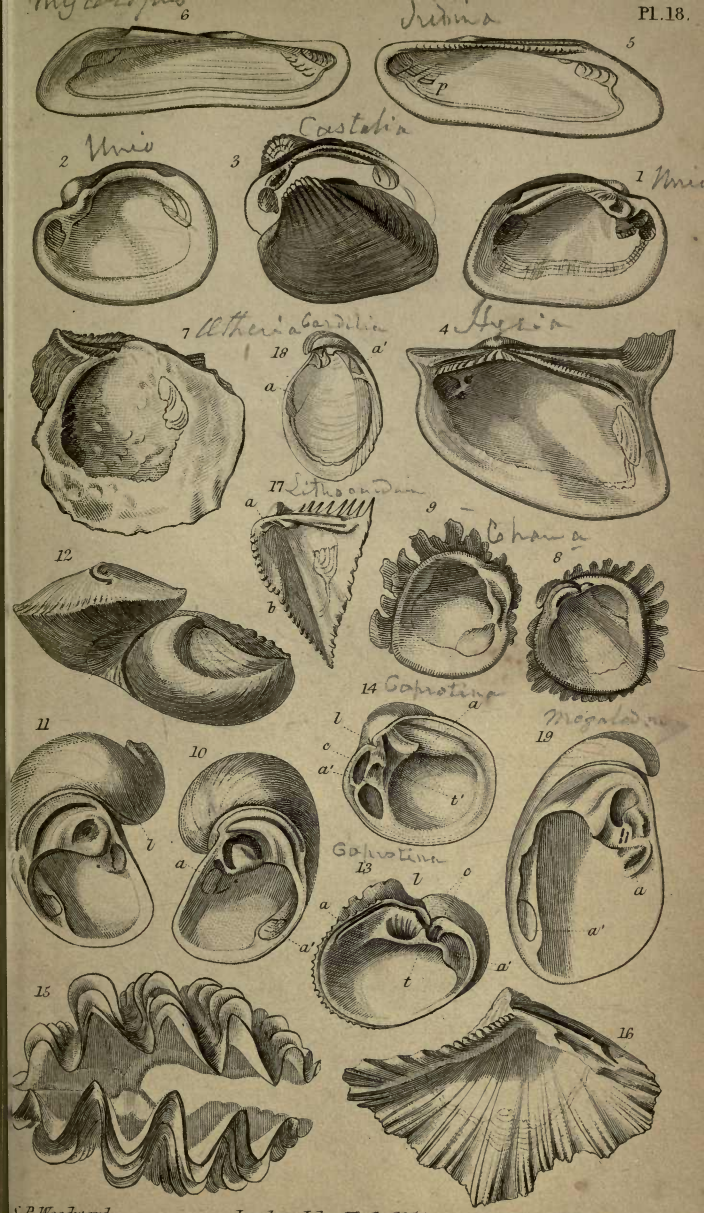
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Iridina
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Castalia
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Unio
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Unio
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Aetheria Cardilia
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Hyria
17
Lithocardium
a
b
9
Chama
8
12
14
Caprotina
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c
a'
t'
Megalodon
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11
l
10
a
a'
Caprotina
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16

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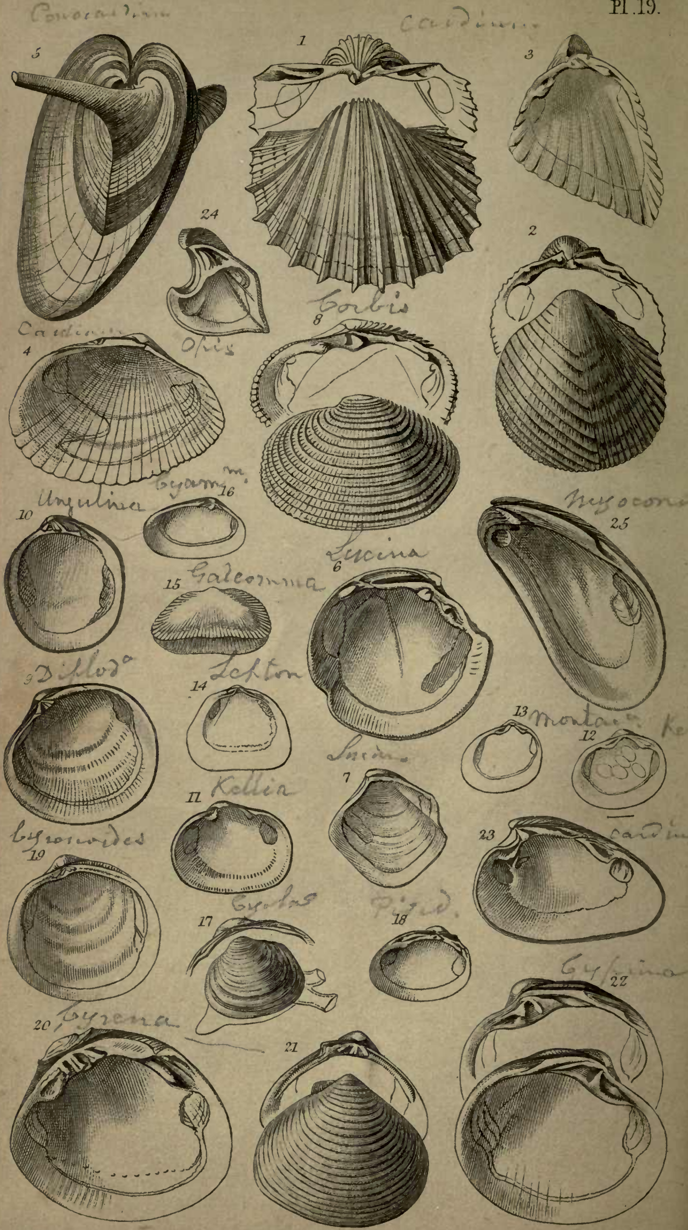
Pl. 19.


Conocardium
Cardium
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1
3
24
2
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Cardium
Opis
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Cyam m.
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Ungulina
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Myocon
25
Lucina
6
Galeomma
15
Diplod^{a}
9
Lepton
14
13 Montac^{a}
12
Kel
Lucin.
11 Kellia
7
Cyrenoides
19
23
Cardi
Cyclas
17
Pisid.
18
Cyprina
22
20 Cyrena
21

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PLATE XIX.

* The figures marked are *left* valves.

Cardiadæ.

	PAGE
1. Cardium costatum, L. $\frac{1}{3}$. China	290
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PLATE XX.

(All the *interiors* are right valves.)

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7.	Venus paphia, L. W. Indies	304
8.	Cytherea dione, L. 2/3. W. Indies	305
9.	——— (*Meröe*) picta, Schum. 2/3. China	305
10.	——— (*Trigona*) tripla, L. 2/3. W. Africa	305
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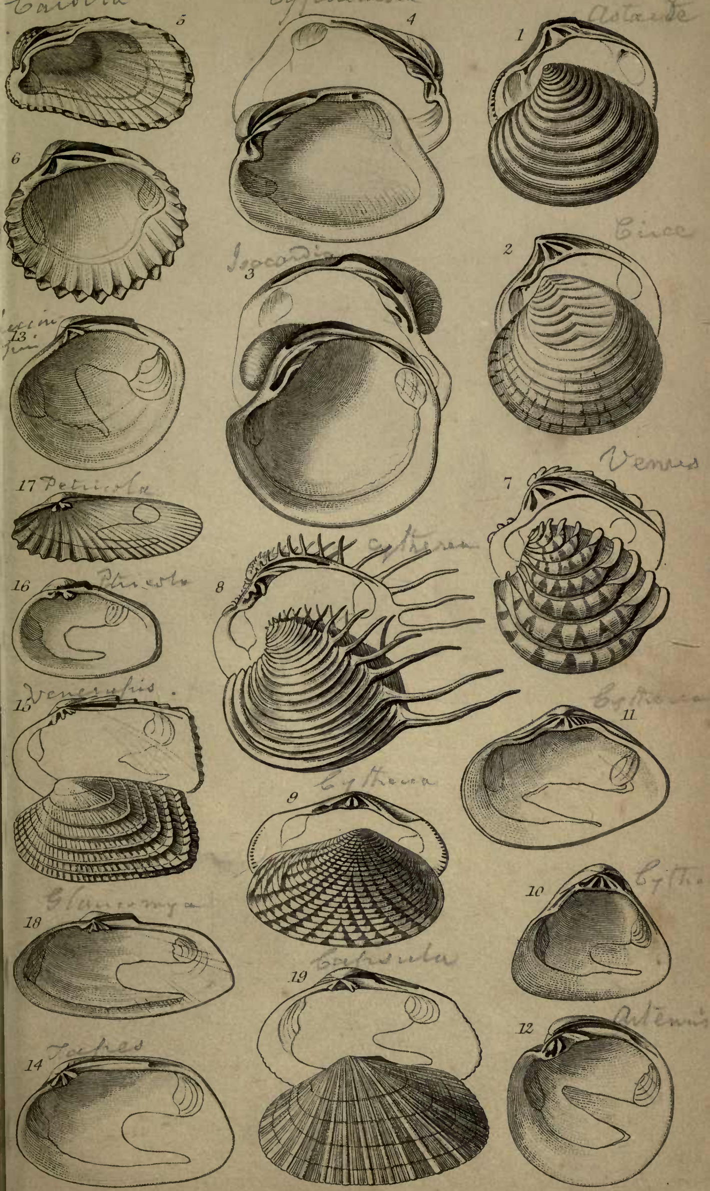
17.	——— pholadiformis, Lam. 2/3. New York	327
18.	Glaucomya Chinensis, Gray. China	327

19.	Capsula rugosa, Lam. sp. 1/2. N. Australia	311


Cardita
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Cypricardia
4
Astarte
1
6
Isocardia
3
Circe
2
ucin
13
fera
Venus
7
17 Petricola
16 Petricola
8
Cytherea
Venerupis.
15
Cytherea
11
Cytherea
9
Cyth
10
Glaucomya
18
Capsula
19
Artemis
12
Tapes
14

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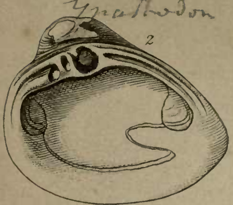
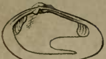
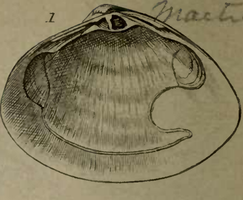

2 Gnathodon


18 Ervilia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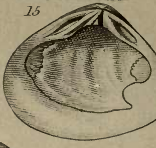
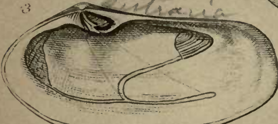
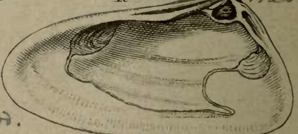
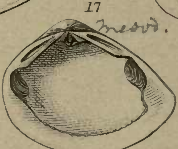

15 Mesodesma


3 Lutraria


16 Mes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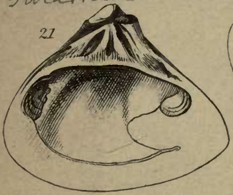
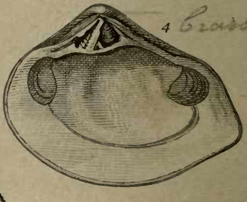

21 Galathea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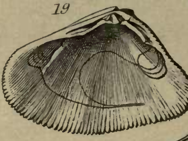
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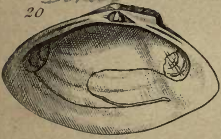
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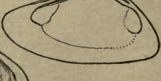
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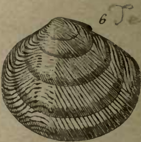
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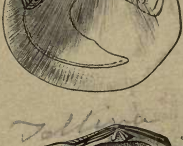
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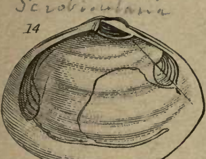
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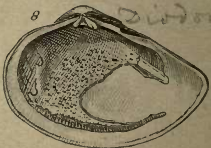
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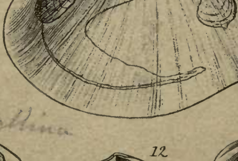
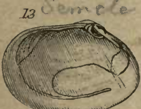

5 Tellina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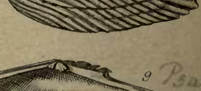
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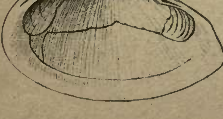
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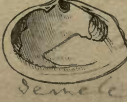
12 Semele

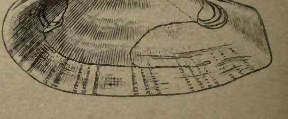
9 Psam

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PLATE XXI.

(All the interiors are *right* valves.)

Mactridæ.

		PAGE
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2.	Gnathodon cuneatus, Gray. ½. New Orleans	308
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4.	Crassatella ponderosa, Gmel. sp. ½. Australia	299

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5.	Tellina lingua-felis, L. ½. Antilles	310
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14.	Scrobicularia piperata, Gm. sp. ½. Brit.	312
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16.	———— (*Donacilla*) donacium, Lam. ½. Peru	313
17.	———— (*Anapa*) Smithii, Gray. Tasmania	313
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19.	Donax denticulatus, L. Antilles	313
20.	——— (*Iphigenia*) Brasiliensis, Lam. ½. Antilles	314
21.	Galatea reclusa, Born sp. ½. R. Nile	314

22.	Tancredia extensa, Lycett. ½. Oolite, Brit.	293

PLATE XXII.

* The figures marked are *left* valves (interiors).

Tellinidæ.

PAGE
1. Sanguinolaria livida, Lam. ½. N. Australia 311
2. ———— diphos, Chemn. ⅓. India 311
3. ———— orbiculata, Wood. ½. S. America 311

Solenidæ.

4. Solen siliqua, L. ⅓. Brit. 315
5. Cultellus lacteus, Spengl. ⅓. Tranquebar 315
6. ———— (*Cerati-solen*) legumen, L. ⅔. Brit. 315
7. ———— (*Machæra*) politus Wood. ⅔. India 316
8. Solecurtus strigilatus, L. ⅔. W. Africa 316
9. ———— Caribæus, Lam. ⅔. U. States 316
10. ———— (*Novaculina*) Gangeticus, Bens. Calcutta 317

Myacidæ.

11. Thetis hyalina, Sby. sp. ⅔. China 319
12. Panopæa Americana, Conrad. ½. Miocene, Maryland 319
13.*Saxicava rugosa, L. ⅔. Brit. — Kamtschatka 320
14. Glycimeris siliqua, Chemn. ⅔. Arctic America 320

Anatinidæ.

15.*Pholadomya candida, Sby. ⅓. W. Indies 322
16. Goniomya literata, Sby. ½. Oolite, Brit. 322

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17. Solemya togata, Poli sp. ½. Medit. 271

Sanguin

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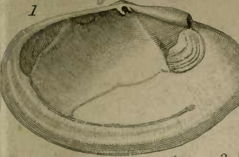

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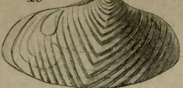
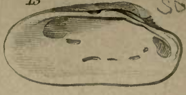


13 Saxica



Sanguinª

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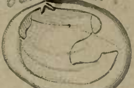
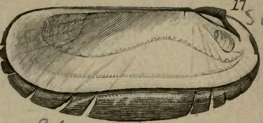


17 Solen



Sanguinª

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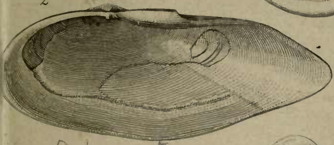
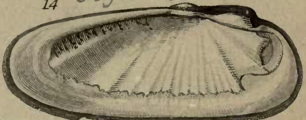
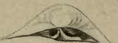


14 Glycimeris





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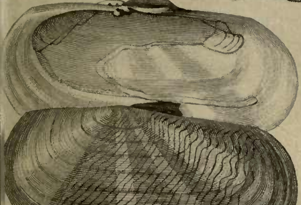
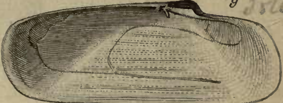
8 Solecurtus



9 Solecurt



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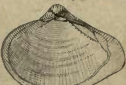
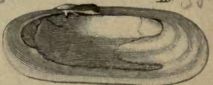
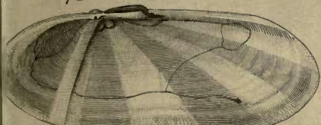


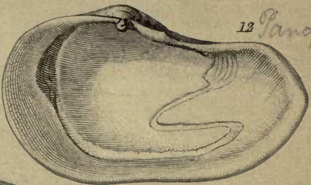
10 Solen



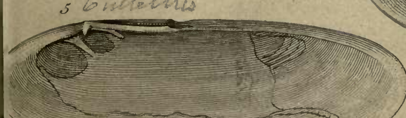
7 Cultellus



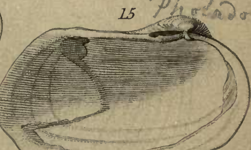
12 Panopaea



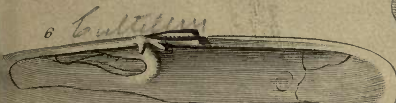
5 Cultellus



15 Pholadomya



6 Cultellus



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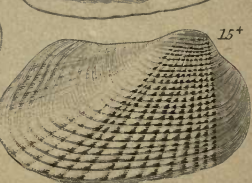
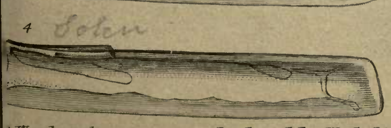


4 Solen



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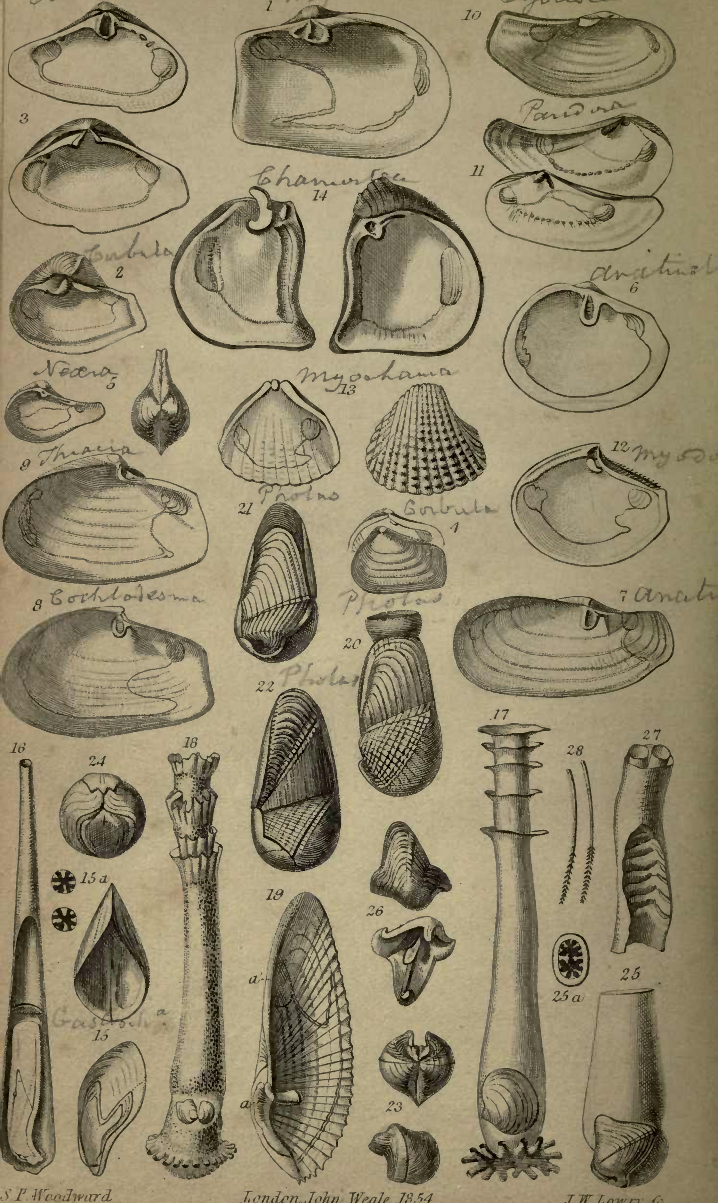
Corbula
Mya
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S. P. Woodward

London, John Weale, 1854.

J. W. Lowry sc.

PLATE XXIII.

* The interiors marked are *left* valves.

Myacidæ.

	PAGE
1.*Mya truncata, L. ½. Brit.	317
2. Corbula sulcata, Lam. W. Africa	317
3. ——— (*Potamomya*) labiata, Maton sp. ⅗. Buenos Ayres	318
4. ——— (*Sphenia*) Binghami, Turt. Brit.	318
5. Neæra cuspidata, Olivi. Brit.	318
6. Anatinella candida, Chemn. ⅗. Ceylon	309

Anatinidæ.

7. Anatina subrostrata, Lam. ½. India	321
8. Cochlodesma prætenue, Mont. Brit.	321
9. Thracia pubescens, Pult. ⅓. Brit.	322
10.*Lyonsia Norvegica, Chemn. sp. ⅔. Brit.	323
11. Pandora rostrata, Lam ¾. Guernsey	324
12. Myodora brevis, Stutch. New South Wales	324
13. Myochama anomioides, Stutch. New South Wales	324
14. Chamostrea albida, Lam. sp. ½. New South Wales	325

Gastrochænidæ.

15. Gastrochæna modiolina, Lam. Galway	325
15a. ——— sp. siphonal orifices, in U. Green-sand, Haldon, Devonshire	326
16. ——— mumia, Spengl. ⅗. India	326
17. Clavagella bacillaris, Desh. ½. Pliocene, Sicily	326
18. Aspergillum vaginiferum, Lam. ½. Red Sea	327

Pholadidæ.

19. Pholas Bakeri, Desh. ½. India	328
20. ——— (*Pholadidea*) papyracea, Solr. ⅔. Brit.	329
21. ——— (*Martesia*) striata, L. W. Indies	329
22. ——— (*Parapholas*) bisulcata, Conrad. California	329
23. Xylophaga dorsalis, Turt. Brit.	329
24, 25. Teredina personata, Lam. London Clay, Bognor	330
25a. ——— siphonal orifice	
26.*Teredo Norvegica, Spengl. Brit.	329
27. ——— siponal end of the tube, broken to show septa.	
28. ——— bi-pennata, Turt. (styles) Brit.	330

PLATE XXIV.

(Tunicated Mollusca described in the Supplement.)

Ascidiadæ.

1. Molgula tubulosa, Rathke. N. Brit.
2. Cynthia papillosa, Brug. sp. $\frac{1}{3}$. Medit.
3. Pelonæa glabra, Forbes, $\frac{2}{3}$. N. Brit.
4. Chelyosoma Macleayanum, Brod. $\frac{1}{3}$. Greenland.
5. Boltenia pedunculata, M. Edw. $\frac{1}{18}$. New Zealand.

Clavellinidæ.

6. Clavellina lepadiformis, O. F. Müll. North Sea.
7. Perophora Listeri, Wiegm. $\frac{2}{1}$. Brit.

Bortyllidæ.

8. Botryllus violaceus, M. Edw. $\frac{2}{1}$. France.
9.*Botrylloides rotifera, M. Edw. France, N. Coast.
10.*Didemnium gelatinosum, M. Edw. France.
11.*Eucœlium hospitiolum, Sav. Medit.
12.*Distomus fuscus, M. Edw. France.
13. Diazona violacea, Sav. $\frac{1}{4}$. Ivica, Medit.
14. Aplidium lobatum, Sav. $\frac{1}{2}$. Gulf of Suez.
15. Polyclinum constellatum, Sav. Red Sea.
16. Parascidium flavum, M. Edw. $\frac{1}{3}$. France.
17.*Amorœcium argus, M. Edw. France.
18. ———— proliferum, M. Edw. (larva). France.
19. Synœcium turgens, Phipps. $\frac{2}{3}$. Spitzbergen.
20. Sigillina australis, Sav. $\frac{1}{3}$. Australia.

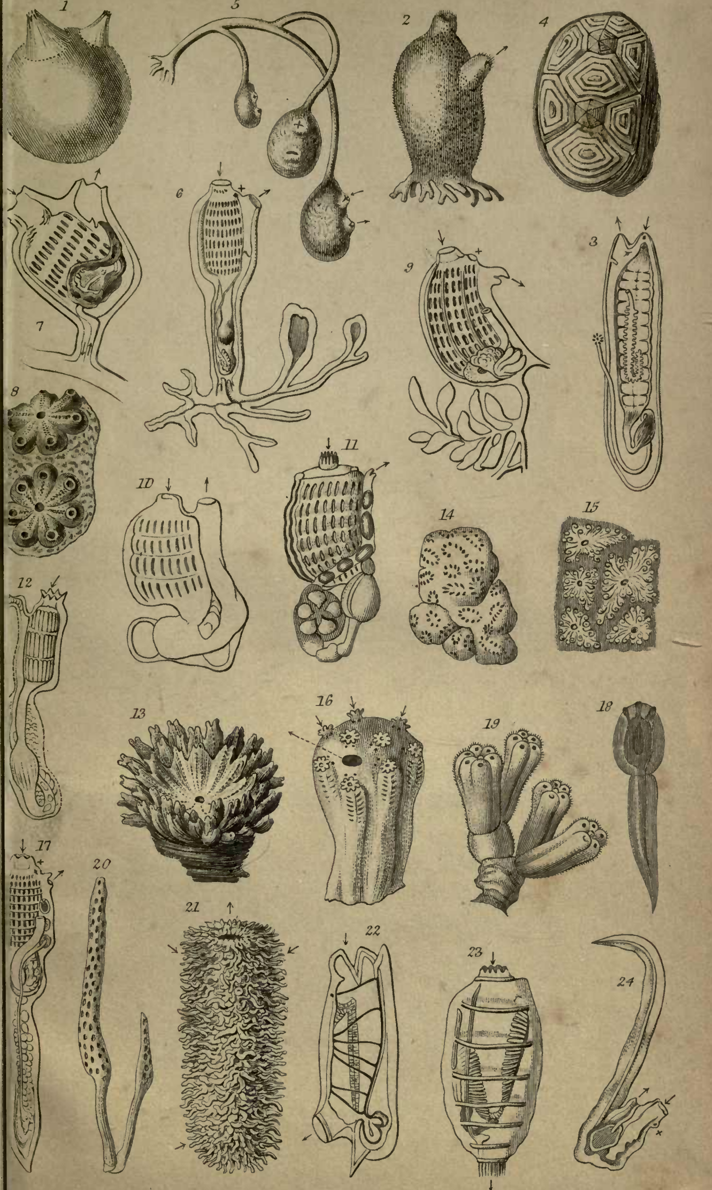
Pyrosomidæ.

21. Pyrosoma giganteum, Lesueur, $\frac{1}{6}$. Atlantic. Medit.

Salpidæ.

22. Salpa maxima, Forsk. $\frac{1}{4}$. Medit. Atlantic.
23. Doliolum denticulatum, Q. and G. $\frac{4}{1}$. New Zealand.
24. Appendicularia flabellum, Chamisso. $\frac{3}{1}$. New Guinea.

* Magnified figures of zoïds separated from the common mass.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